

## ESD

Code → Generally accepted guidelines recommended for the industry to follow.

↳ Not need to be followed but compliance is best practice.

Standard → How to do

↳ Two types:

i) Voluntary standards: established by private-sector body and made available to persons or organizations.

ii) mandatory standards: mandatory standard requirement by Govt.

Specification → provide scientific requirements for the material, construction or service used in an application.

↳ Grounding system is an example.

Regulation → incorporate codes and standards, are mandated by a Govt body and required by law to be complied with.

Statute → New law made by legislature.

Act → formal title of statute.

Ordinance → created by local legislature. (city and country Govts)

Regulation → legal directive written to explain how to implement statutes.

Opinion → explanation by a judge or group of judges.

Q3P

## Terminology:-

Apparatus :- energy efficient apparatus, includes all machines, appliance and fittings in which conductors are used on of which they form a part.

Appliance → Electric current equipment

BDB :- Branch distribution board. Located same floor of a building and connected to one of the SDBS in the same floor.

Ceiling rose :- Used for terminating the point wiring for a light or fan in the ceiling. Brass terminal.

Earth electrode :- For electrical connection to ground.

EDB :- Emergency distribution board. 3rd of main cable → EDB → ESDB.

Luminaire :- complete light fitting consisting of lamp, holder etc.

(fixed fittings) (portable) local to fixture → portable framework of good quality of material. Without light → portable

Subject to quality no fixture is for portable

## ESP

Earthing → Exposed conductive part of electrical equipment and extra-neutrely conductive parts of earthed bodies to the general mass of earth.

→ Helps facilitate the opening of OC protection devices in case of earth faults.

→ equipment earthing → Earthing of non-current carrying metal work.

→ connect equipment or metallic parts which don't carry current under normal conditions.

Grounding → connecting the current carrying parts to the earth

→ Neutral point is connected to ground for distribution transformers.

→ solidly grounded or resistance grounded (for mines)

## Earthing

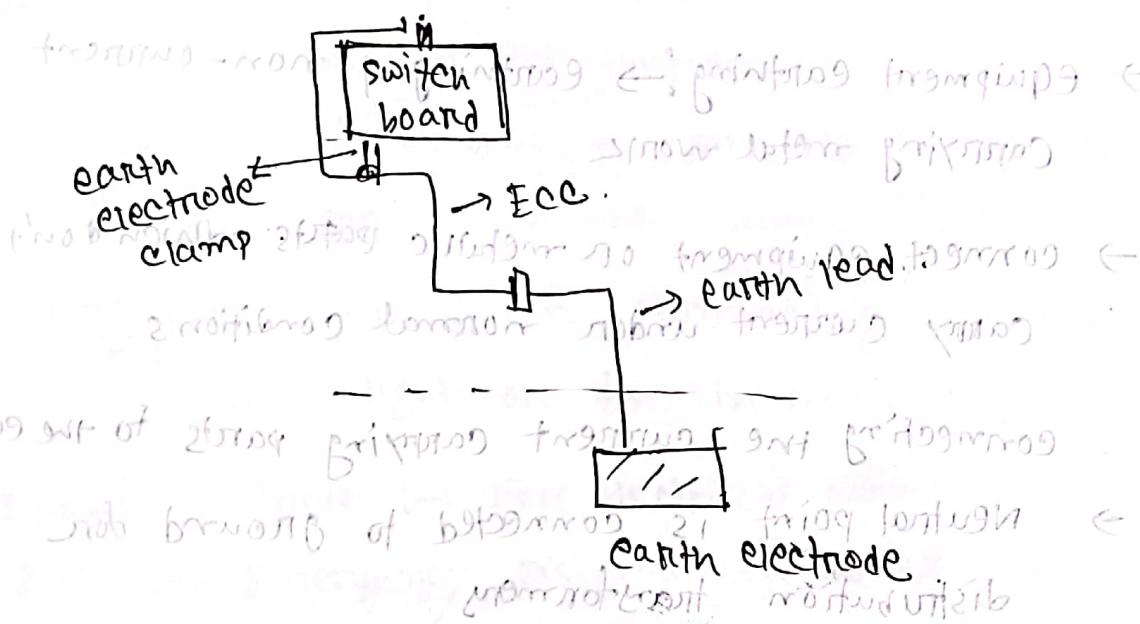
- protects human from electric shock
- green color.
- Used for avoiding shock
- located under earth pit b/w equipment and ground

## Grounding

- protects entire power system.
- black color.
- used for avoid unbalancing on ckt.
- located b/w neutral and the grounding.

## Integral parts of earthing:-

- Earth electrode
- Earth lead cable/wire
- Earth continuity conductor (ECC)
- Earth electrode clamp



## Earth electrode:-

### a) Cu rod earth (electrode)

- min. Dia 12.5 mm
- u length 3.33 m
- resistance 1 Ω

### b) Cu plate earth electrode

- min. size 600 mm x 600 mm x 6 mm.
- resistance 0.1 Ω

### c) Galvanized iron pipe

- min. Dia 38 mm
- u length 6.5 m
- 1 Ω

## \* Earth lead

- b/w earth electrode and the earthing busbar or b/w n u u u LT panel of n u .
- PVC insulated wiring cu cables (BYA) is used. Green + yellow bi-color insulation.

## \* EEC

- Links earthing busbars at the LT panel or MDB of a building.
- Joins or bonds together all the metal parts of an installation.
- PVC insulated / sheathed (BYA/BYm) cu cables are used.

## Earth electrode clamp

- Effective connection of EEC, earth lead and earth electrode.

### Bonding

- \* joining 2 electrical conductivity is bonding.
- connecting 2 or more metallic object to form equipotential between them is called bonding.
- Equipotential b/w 2 lt metallic part वर्ग क्रिया current flow रूपी।

### Earthing pit

- constructed around the top of the earth electrode
- dimension 600 mm X 600 mm X 600 mm
- made such that water cannot get into the pit.

\* Several indexes for lightning protection:-

- i) Use of structure.
- ii) Type of construction.
- iii) Consequential effects.
- iv) Degree of isolation.
- v) Type of terrain.
- vi) Height of structure.
- vii) Lightning prevalence.

Index শূলক বিন্দুর মানে, এশূলক প্রতি মানে যদি পর মার্গিন রিস্ক মানে যেকে কম হয়ে, তখন প্রতি

#### Integral parts of an LPS

- i) Air spike or Air terminal (AT)
- ii) down conductor.
- iii) Roof u. → link all AT and down conductors.
- iv) Earth electrode.

AT → intercept lightning discharges

→ consists of a vertical thick conductor of round cross section.



→ made with copper rod.

## LPS Design

\* Number of Arrestors =  $\frac{\text{Roof perimeter (ft)}}{25}$

\* If roof area < 100 sq.m, then 1 down conductor.

\* If roof area > 100 sq.m, then one down conductor for the first  $80 \text{ m}^2$  + further one for every  $100 \text{ m}^2$ .

If Area  $321.58 \text{ m}^2 > 100 \text{ m}^2$

then for first  $80 \text{ m}^2 \rightarrow 1$  rd.

For next  $(321.58 - 80)/100 = 2.4$  or 3

so, total 4

\* Roof conductor link all AT and down conductor to ground electrode(s).

"protection zone" → "space" within which an air spike provides protection by attracting the stroke to itself.

Clearance of protection zone :-

$$D = 0.3R + \frac{H}{15} \rightarrow \text{height of building (m)}$$

$D$  = clearance in meters  
 $R$  = resistance to earth in ohms  
 $H$  = number of down conductor electrodes.

from 1607 formula

using refigored profle

2nd question Xinggong 100 fine 10099? (2)

## Surge Arresters Selection :-

Refined 295

→ (i) protective device for limiting surge voltages by discharging or bypassing surge current through

→ protect OH lines, XFR and protect outdoor substation from lightning voltage.

## Horn gap LA

→ used for low and medium voltage off ring

$$E_{LA, P.S} = 0.1 \times (0.3 - 32 + 1.58) \text{ kV/m not}$$

Data / Telecommunication for buildings.

TWO types of conduit:-

i) concealed telco wiring. (building एवं फॉर्म)

ii) surface u " (u एवं सर्फेस)

fire detection and Alarm system

## key components

- fire monitoring & control

i) Automatic detector

ii) Alarm

iii) Fire Alarm control panel (FACP)

iv) manual call point

v) Interconnection cables

vi) Special unit for emergency response.

Manual call point → manually operated device to initiate fire alarm

→ 1.2 to 1.6 m height.

→ on all storey exists and all exists to open air.

Smoke detectors

→ For early warning of Fire

→ Ionization type are suitable for fast and flaming fires.

→ Optical detectors are suitable for smouldering fires.

Heat detectors

→ Warns of fire when temperature reaches a certain level

→ Suitable for locations where smoke detectors can't be used.

Aspirating smoke

detector → consists of a central detection unit which draws air through a network of pipes to detect smoke.

→ Nephelometer detects presence of smoke

Flame detector → Responds to short wavelengths (UV/IR) coming from very high temp. as available in flames (50-65 meter range)

→ heat sensor

3 Types of fire alarms:-

- i) Audible alarm (sounders)
- ii) Visible alarm (strobes / beacons)
- iii) Voice speaker

Ex:

Used where it is too noisy

the ambient noise  
is such that audible  
warning may not be

Bells, horns, sirens  
etc. Max. sound level  
is 120 dB(A)

FACP → indicates in which detection circuit an alarm or fault condition has been generated.

Cables for fire detector:-

- Requirement:
- BS 5839-1 type cable
  - Fire proof cable
  - Enhanced fire resistance cable
  - Red colored with white stripes

Fire detection zones → convenient way of dividing up a building to assist in quickly locating the position of fire

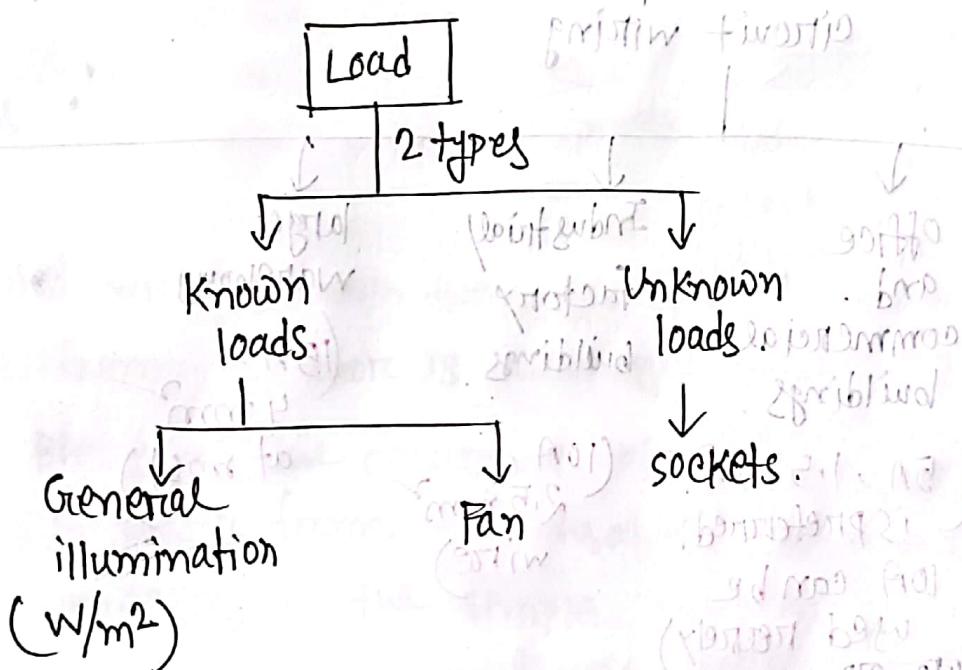
CCTV → Two types of conduit → surface

→ concealed

## \* several types of Testing

- i) Periodic inspection
- ii) inspection of the color identification of cable
- iii) u u earthing terminals, earthing bus.
- iv) Insulation test
- v) Earth resistance test and the continuity resistance test. → shall not exceed 1 Ω

## Last step: Inspection



\* Distribution Board : i) junction point of the incoming line and the outgoing lines.

ii) must have circuit breaker or fuse protection.

iii) Junctions are made through

use of terminal block in primary to reflect to secondary part repeat as per need.

## Distribution Box

\* main incoming cable entry and feed connection of large building.

FDB  
located in each floor

DB  
Feed SDB

SDB

BDB

$\text{MDB} \rightarrow \text{FDB} \rightarrow \text{DB} \rightarrow \text{SDB} \rightarrow \text{BDB}$

## Circuit wiring

box

Domestic and office buildings.

(5A, 1.5 mm<sup>2</sup> wire)

Office and commercial buildings.

(5A, 1.5 mm<sup>2</sup> is preferred, 10A can be used rarely)

Industrial factory buildings.

(10A, 2.5 mm<sup>2</sup> wire)

large warehouse (15A, 4 mm<sup>2</sup> at most)

(6mm<sup>2</sup>)

wiring  $\rightarrow$  current up to 20 :-

less than

\* With more than one outlet,  $\sim 50\%$  loading of circuit, branch circuit must have spare capacity. (20%)

\* Size of cable shall be at least one size larger than needed.

\* 4 mm<sup>2</sup>, 6 mm<sup>2</sup>  $\rightarrow$  for 15 A socket.

\* length of lightning circuit shall be limited to 30 m, if voltage less than 1V, length may be longer than 30 m

- \* Use of common neutral for more than one circuit is prohibited
- \* Following the appropriate new color codes of cables.

Three phase →

- live 1 → Red
- live 2 → Yellow
- live 3 → Blue

- \* Balancing of CHT's in 3-phase DB's.

Surface wiring	Exposed wiring	→ दृष्टिकोण से नियम.
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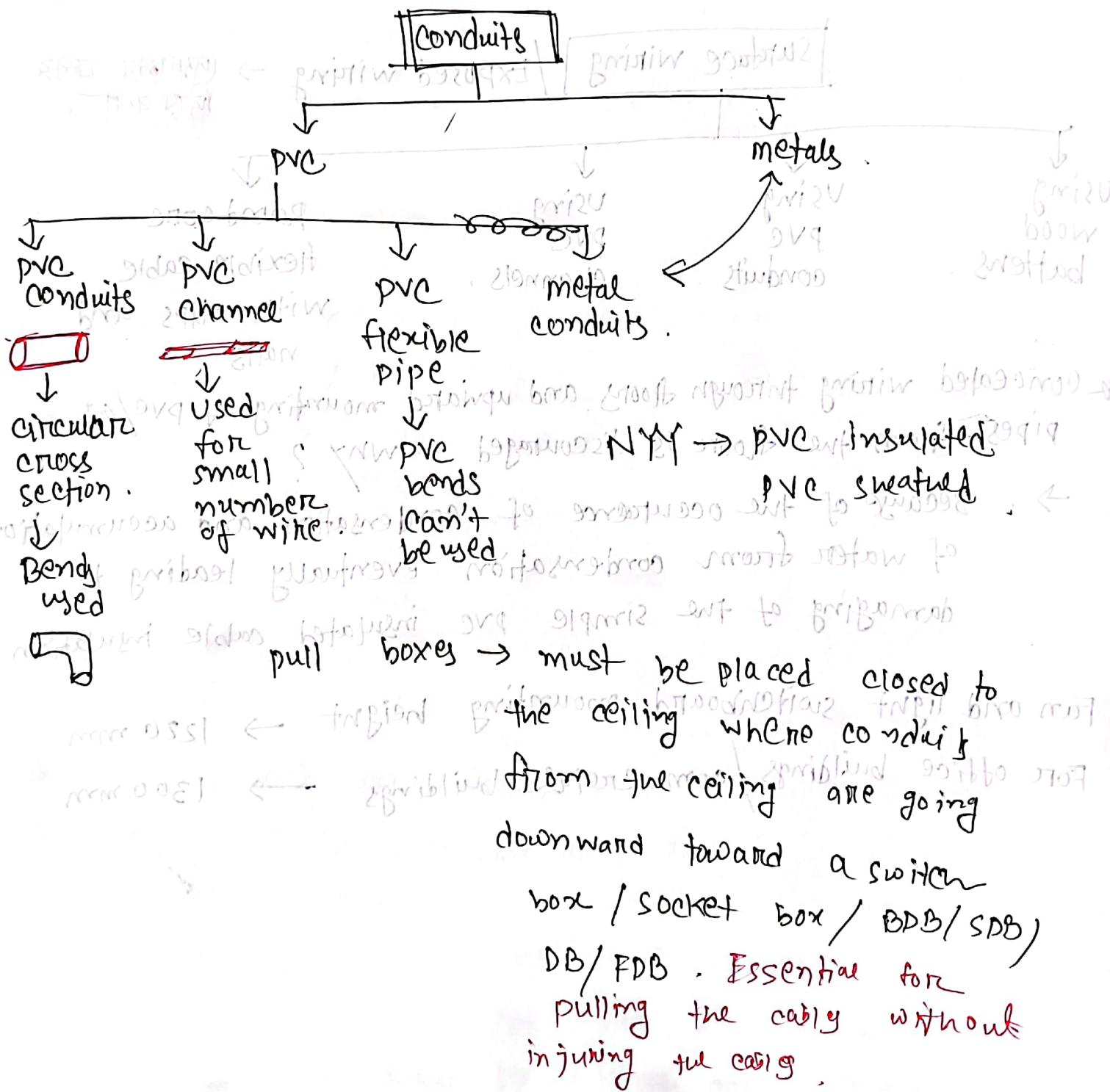
↓ Using wood battens.	↓ Using PVC conduits.	↓ using PVC channels.	↓ Round core flexible cable with clips and nails.
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- \* Concealed wiring through floors and upward mounting of PVC/GI pipes from the floor is discouraged → why?
- Because of the occurrence of condensation and accumulation of water from condensation eventually leading to damaging of the simple PVC insulated cable insulation.

- \* Fan and light switchboard mounting height → 1200 mm  
For office buildings / commercial buildings → 1300 mm

point wiring → wiring between a light / fan point and its corresponding switchboard is termed as point wiring.

circuit wiring → wiring between a switchboard and a BDB/SDB. DB will be called circuit wiring.



Busbar Trunking (BBT)  $\rightarrow$  for high rise building, LT BBT is used instead of riser main cables to minimize space in the vertical electrical shaft, to minimize the risk of spreading fire which may happen with bundles of insulated cables.

Requirements of a substation room :-

Height  $\rightarrow$  3.0 to 3.6 m  
minimum recommended spacing b/w XFR periphery and walls should be :-

i) 0.75 m XFR installed in a room with wall on two sides.

ii) 1.16 m XFR installed in a room with wall on 3 sides.

iii) 1.25 m XFR installed in a room with wall on 4 sides.

iv) 1.5 m distance from one to another XFR for multiple XFRs in room for 11kV voltage level and 2.5m for higher voltage level.

9200 are required for 6000 - 5000  
9000 after 9000 in

For power rating up to 2 MW, two types of indoor XFRs have been widely used :-

i) oil type natural cooled XFR (ONAN)

ii) cast resin dry type natural cooled (AN).

Used in where space saving is mostly important.

Used where space is available to accomodate the risk of spreading of fire.

### Standby power supply

\* In building where electrical power interruption causes production loss.

\*\* Standby power supply like IPS, UPS, petrol/Diesel engine etc.

### Generator power supply

\* Generator to wall distance should be 1m.

\*\* " gen. " " " " 1.5 m.

\* Generating set in substation room should be far from main, apart -

i) avoid vibration and noise.

ii) negligible voltage drop.

## Installation of an UPS:- / a UPS

- i) should be kept as small as possible.
- ii) Battery maintenance should be done at least every 15 days.
- iii) Inflammable materials must not be kept in the vicinity of the UPS.
- iv) For 200-500 VA UPS, 3A fuse protection needed.
- v) For 600-700 VA UPS, 5A protection.

## Installation of rooftop solar PV.

### Integral parts of a conventional solar PV:-

- i) Solar PV panels.
- ii) Battery charge controller.
- iii) Inverter.
- iv) Cables b/w solar PV panel and battery charge controller.
- v) Cables b/w inverter and the DBS.
- vi) Other cables and accessories.

## power distribution system

Designing procedure:-

- i) Advice of an electrical design engineer.
- ii) All electrical apparatus shall be suitable for voltage and frequency.
- iii) The number and types of connection required.
- iv) Suitability after the requirements of the installation, including max. demand.
- v) Expense.

## High voltage switchgear

Selection of the type of HV switchgear for any installation should consider the following →

- i) voltage of the supply system.
- ii) Isc at the point of supply.
- iii) size and layout.
- iv) availability of SS room.

# **Selection of Appropriate Type of Lamps**

## **1.2.8 Selection of Appropriate Type of Lamp**

The lamps which are used for various purposes are:

- (i) General Service Lamp (GSL)/Incandescent Lamp
- (ii) Fluorescent Lamp (FL)
- (iii) Compact Fluorescent Lamp (CFL) - Energy Saving Lamps
- (iv) LED Lights
- (v) Halogen Lamp
- (vi) Mercury Vapour Lamp
- (vii) Metal Halide Lamp
- (viii) HP Sodium Lamp
- (ix) Low Pressure Sodium Lamp
- (x) Solar PV Cell Powered LED Lights

## (i) GSL/Incandescent Lamp

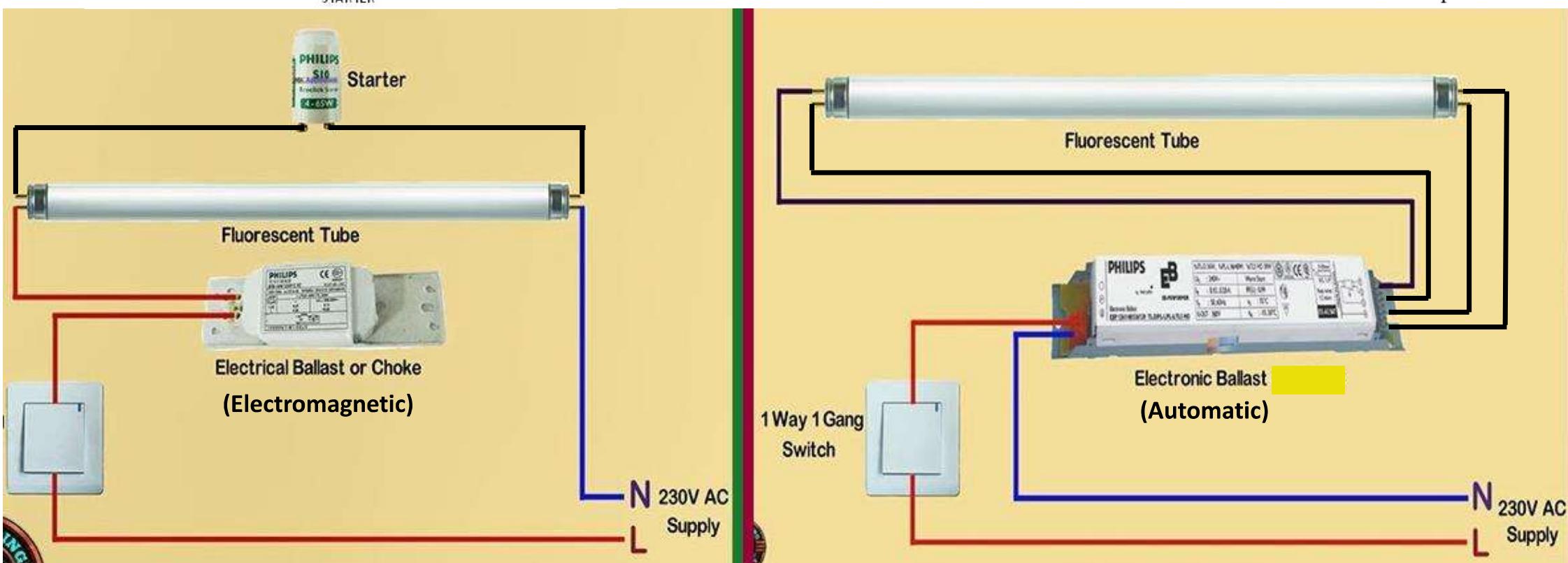
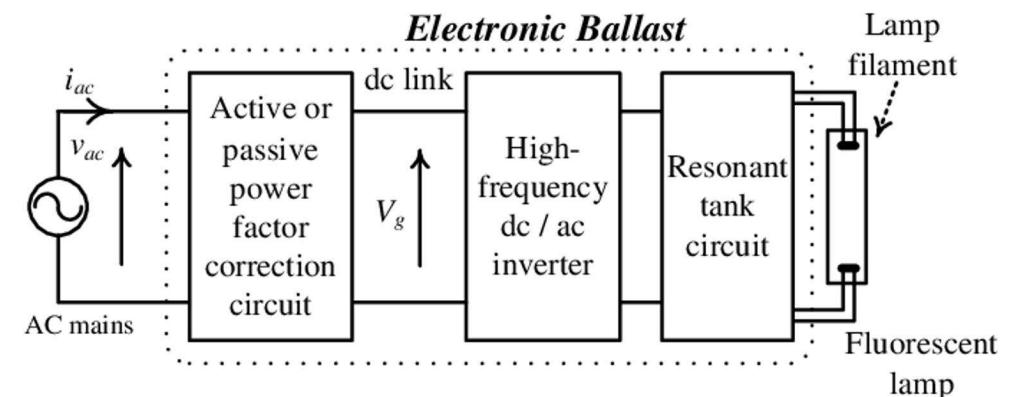
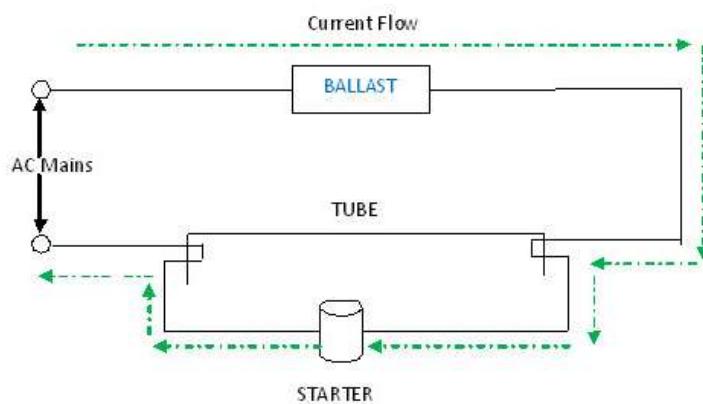


- Available in 40 W, 60 W, 100 W, 150 W and 200 W.
- These lamps produce heat, so **low efficiency**.
- For kitchen, cooking areas, serving counter of food shop/restaurant, porch these are essential because of their CCT (2700K).
- For living room, toilet, corridor, veranda, bed room these have been used for long. Efficient choices are available nowadays, so being **obsolete**.

## (ii) Fluorescent Lamp (FL)



- These are available in 20 W and 40 W ratings. These lamps are recommended for reading room, academic buildings, laboratories, office room, commercial space, factory, illumination of areas around industrial plant and machinery, exterior lighting applications.
- 40 W FL (more energy efficient compared to a 20 W FL) should be used wherever possible.
- These are long life lamps, have wide applications and are advantageous in many respects.



### **(iii) Compact Fluorescent Lamp (CFL)**



- Available in watts ratings of 4 W, 7 W, 11 W, 14 W and 24 W.
- CFLs found wide application for their high light output to watt ratio (efficacy) before the commercial availability of LED light (so, began to call Energy Saving Lamp).
- It is worthwhile mentioning that fluorescent lamp with high quality (electronic) ballasts closely meet the energy saving purpose of CFL.

## (iv) LED Lights



- An LED operates at very small (DC). These are good for lighting, energy efficient, have almost negligible heat dissipation.
- These are good for relaxed environment interior lighting.
- LED light has become more and more popular because of much lower power consumption (i.e. high efficacy) compared to other lamps.

## (v) Halogen Lamp



- Halogen lamps are used for spot lights, decorative lights in shops and commercial spaces, inside show cases, stage lighting, and projection lights. Due to **high temperature rise and UV light output** these should be **avoided** for **interior lighting** unless needed.

## (vi) Mercury Vapour Lamp

- These have been widely used for **shops**, streets, for high bay lighting, warehouse lighting and similar special lighting.
- Most likely, this type of lamp will be discontinued soon due some of it's ill effects. Metal halide is a better alternative to mercury vapour lamp.



## (vii) Metal Halide Lamp



- Available in watt ratings of 150 W, 200 W, 250 W, 500 W, 1000 W, 2000 W.
- Good for **exterior** lighting, indoor and outdoor athletic facilities, for high bay lighting, warehouse lighting.
- These are required where **massive flood lighting** is required from high altitudes for coverage of large areas.

## (viii) HP Sodium Lamp



- Available in watt ratings of 40 W, 50 W, 70 W, 100 W, 150 W, 250 W, 400 W, 1000 W.
- Good for **exterior lighting**, lighting for areas where higher concentration of vehicles and people exist e.g., avenue light, street light, building exterior lighting, security lighting.

## (ix) LP Sodium Lamp



- For **outdoor** lighting such as street lights and security lighting where faithful color rendition (i.e. CRI) is considered **unimportant**.
- This type of lamps may be used for street lights, observatory, parking lot and similar types of areas.

## (X) Solar PV Cell Powered LED Lights



- These fittings require a solar panel, a storage battery system apart from the cluster of LEDs.
- For outdoor lighting such as street lights, security lighting, outdoor parking area, rural market and other social gathering places, this type of light fitting are used.

# High Power LED Lights



- LED lights are replacing almost all the low power lights.
- Now a days, all the **high power lights** discussed above, also have their **LED alternatives**.