01

Illumination Technology: EET463

Faculty- In Charge:
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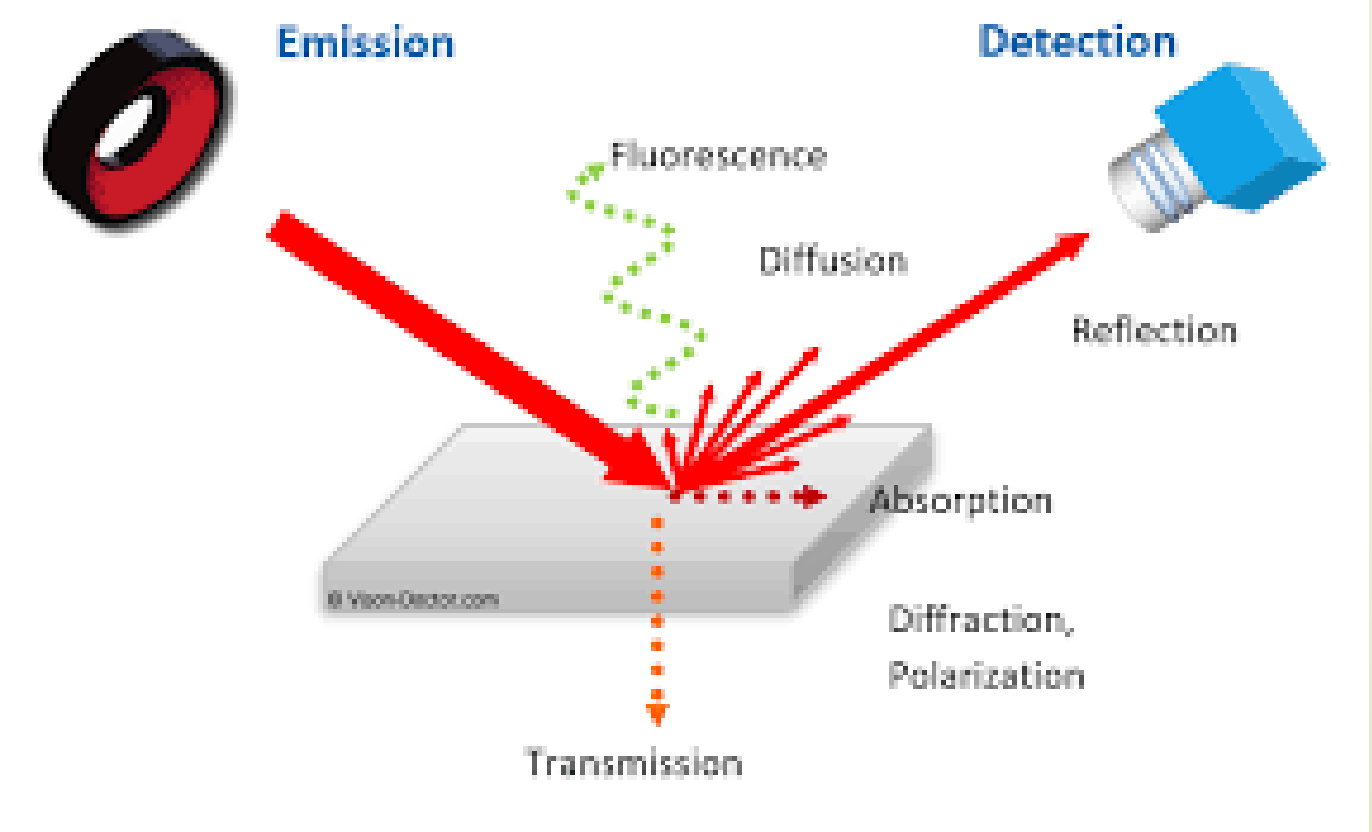
Syllabus

Module 1

Introduction of Light: Types of illumination, Day lighting, Artificial light sources- artificial lighting and total lighting, Quality of good lighting, Factors affecting the Physical processes- Incandescent and Halogen lamps, Fluorescent lamps, LPSV and HPSV lamps, mercury vapour lamps, metal halide lamps, LED lamps- modern trends. Supplementary lighting- shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localised, Different types of Luminaires

Light is a form of Electromagnetic energy, radiated from a body which is capable of being perceived by the human eye.

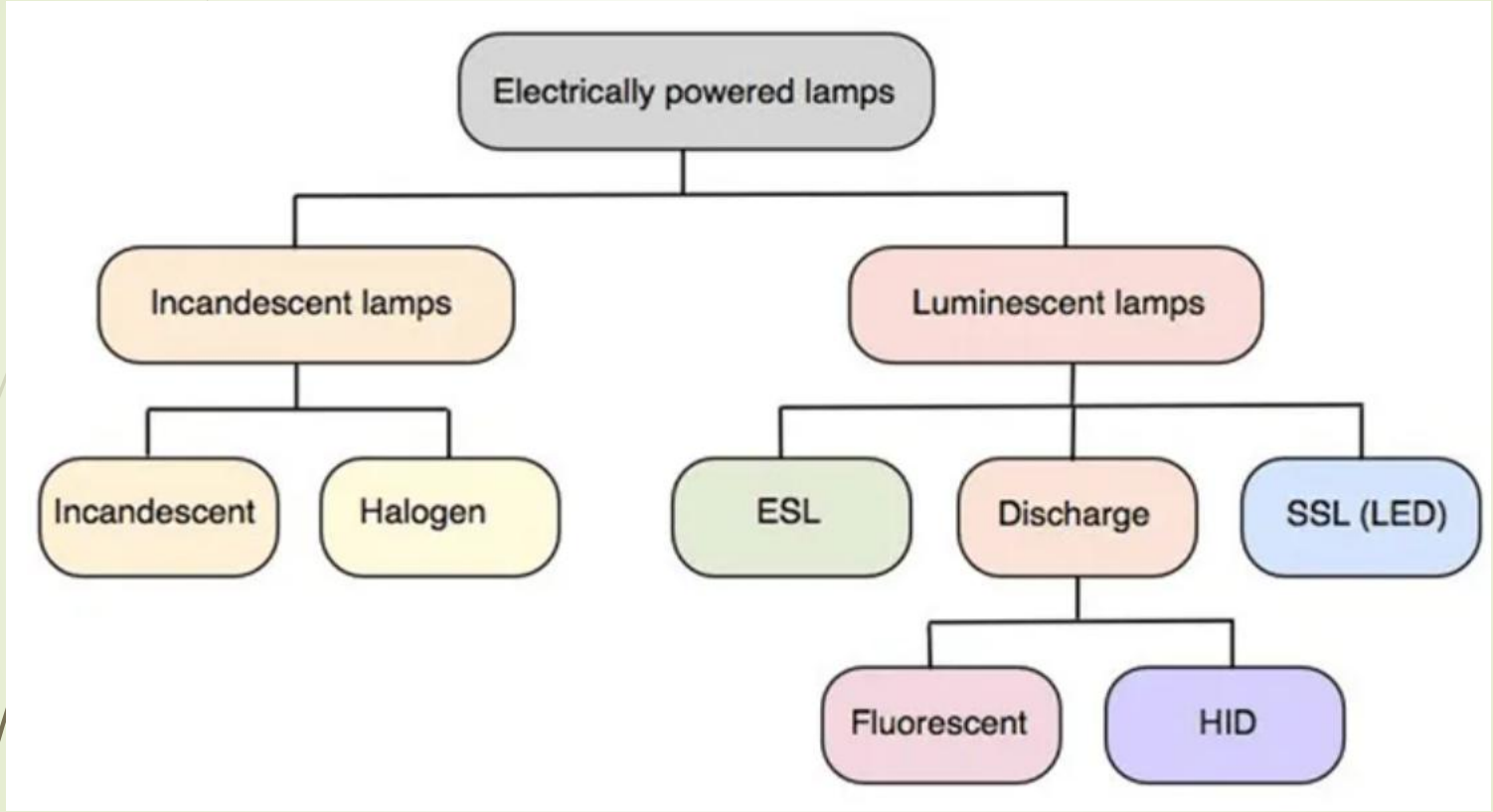


For Good lighting system:

- Adequate illumination of suitable colour on the working surface
- Good maintenance
- Avoidance of hard shadows
- Avoidance of Glare.

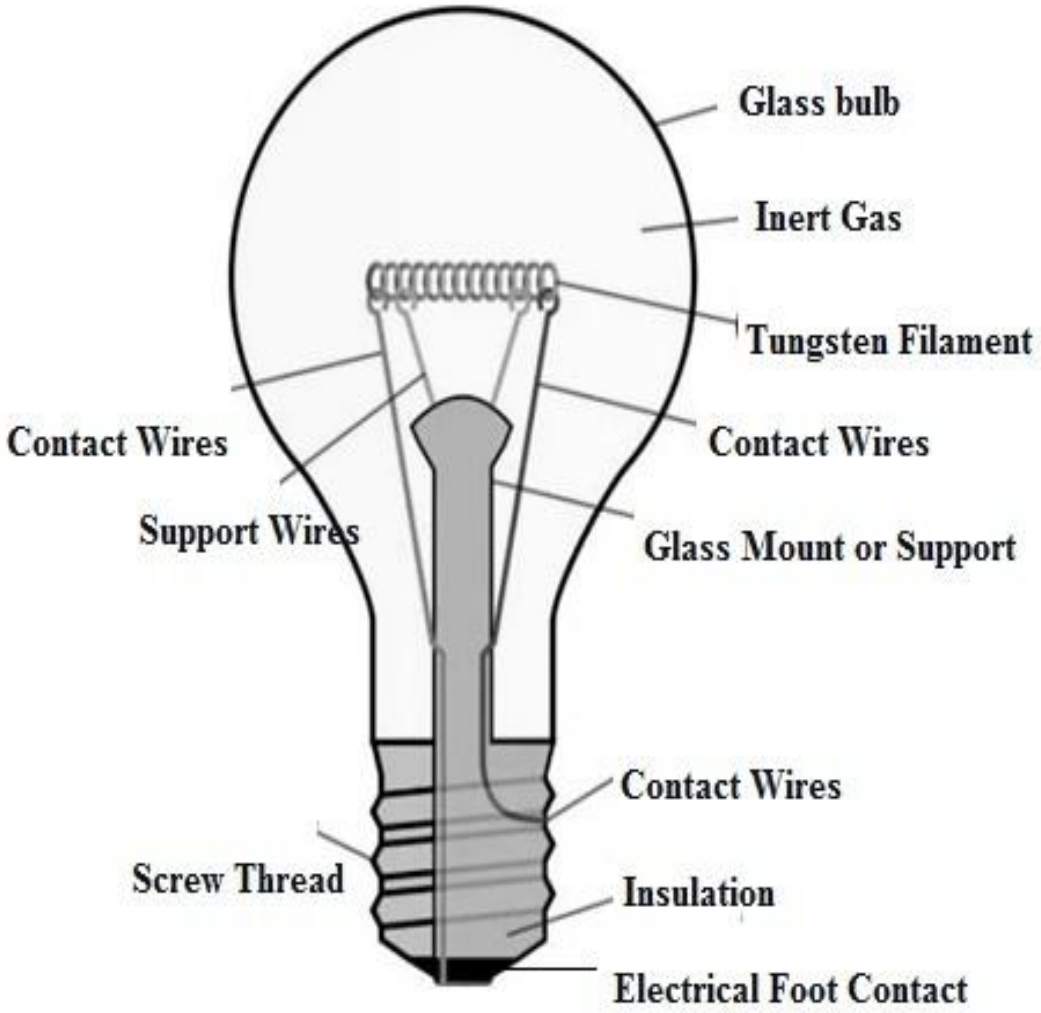
Good illuminance ensures increased production, effectively of work & reduced accidents.

Types of Lamps



Electron-stimulated luminescence (**ESL**)
Solid State lighting
High Intensity Discharge (HID) Light

Incandescent and Halogen lamps



FLUORESCENT LAMPS

- A **fluorescent lamp**, or **fluorescent tube**, is a low-pressure mercury-vapor gas-discharge lamp that uses fluorescence to produce visible light.
- An electric current in the gas excites mercury vapor, which produces short-wave ultraviolet light that then causes a phosphor coating on the inside of the lamp to glow.
- A fluorescent lamp converts electrical energy into useful light much more efficiently than an incandescent lamp.
- luminous efficacy of fluorescent lighting systems is 50–100 lumens per watt, the luminous efficacy of an incandescent bulb may only be 16 lumens per watt.
- Fluorescent lamp fixtures are more costly than incandescent lamps because, among other things, they require a ballast to regulate current through the lamp, but the initial cost is offset by a much lower running cost.
- Because they contain mercury, many fluorescent lamps are classified as hazardous waste.


OSRAM


LEVITON
660 W
660 W


MISE EN GARDE


OSRAM FH 14W/840
Radium NL 18W/840

1. Vacuum lamps

3. Halogen Lamp

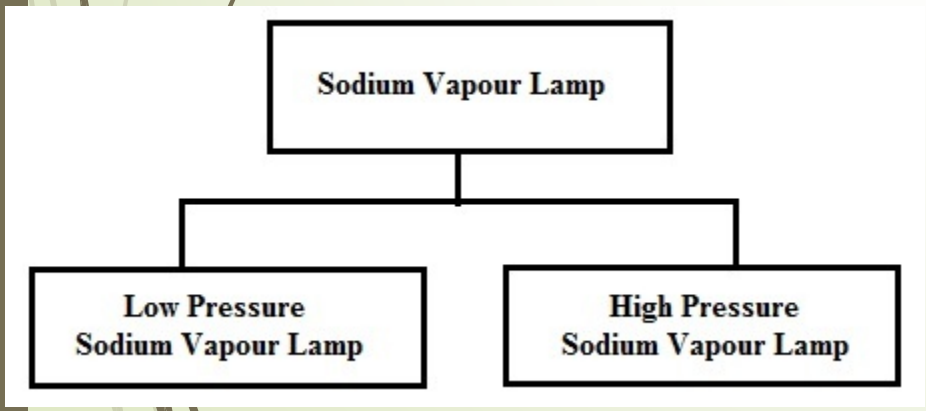
2. Gas filled Lamp

4. Discharge Lamp

5. Fluorescent Lights

Types of Lamps: **LPSV and HPSV lamps**

- A lamp in which an electric discharge takes place throughout a metallic vapor is known as a vapor lamp. These lamps are available in two types like sodium vapor lamp and mercury vapor lamp which emit different colors of lights like thick blue and yellow color respectively.
- These types of lamps are very efficient & provide light with high intensity which is applicable in open areas and also for illuminating large distances.
- MERCURY VAPOR LAMP: A gas-discharge lamp that uses sodium (Na) in an exciting condition to generate light at a 589 nm of characteristic wavelength is known as a sodium vapor lamp. These lamps were commercially designed first sodium lamps by Philips in the year 1932, Holland.



Types of Lamps

Lighting Schemes

1. Direct Lighting:-

- About 90% to 100% of the total light flux is made to fall directly upon the working plane (falls downwards) with the help of suitable reflectors.
- Most commonly used for internal lighting.
- Mainly used for Industry & general outdoor lighting.
- Disadvantage: Causes hard shadows and glare.

2. Semi-Direct Lighting

- 60%-90% of the total light flux is made to fall directly downwards with the help of semi-direct reflectors.
- Remaining light is used for illuminate ceilings and walls.
- It is used for general lighting where ceiling also should be illuminated
- Causes soothing brightness.

3.Indirect Lighting

- More than 90% of the total light flux is thrown upwards to the ceiling for diffused reflection by bowl reflectors.
- Causes soft, glare-free, diffused illumination.
- Used for decorative purposes in cinemas, hotels, theatres, etc.
- Advantage; It gives a glarefree diffused light flux with soft shadows.

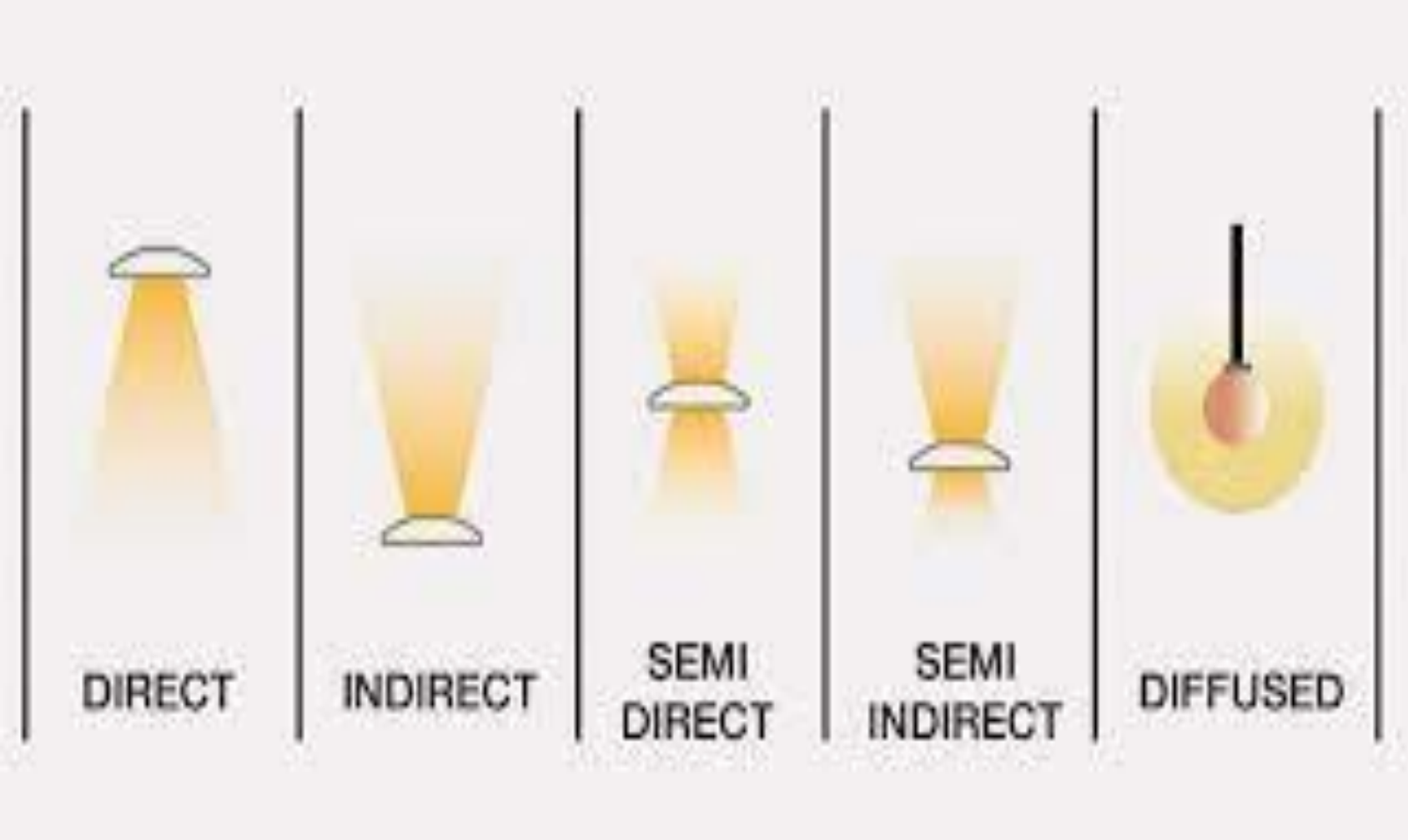
4. Semi-Indirect Lighting:-

- 60%-90% of the total light flux is thrown upwards to the ceiling for diffused reflection by using inverted reflectors.
- The remaining light reaches the work plane directly except for some absorption by the reflectors.
- Causes soft shadows and glare free lighting scheme.
- Used for indoor light decorations.

5. General Lighting

- In this method the bulb and the reflector are made of diffuse glass, so as to give uniform illumination in all direction.
- Causes diffused and glare-less lighting, same illumination in all directions.
- Eg: Wall lights, Ceiling lights, dimmers and lower wattage lights, fluorescent lights.

Lighting Schemes



DESIGN OF INDOOR LIGHTING SCHEMES

I. Adequate illumination
II. Uniform light distribution all over the working plane.
III. Light of suitable colour.
IV. Minimum hard shadow and glare

Factors affecting Lighting:

- Shadow
- Glare
- Reflection
- Stroboscopic effect
- Colour Rendering

Factors affecting Lighting:

1. Shadow

- A **shadow** is a dark (real image) area where light from a light source is blocked by an opaque object. It occupies all of the three-dimensional volume behind an object with light in front of it.
- *Characteristics:*

i) It depends on shape of the object. The shadow increases & decreases in the ratio same as the shape of the object.

ii) It depends on source of light whether it is plane, parallel rays or spherical.

iii) It depends on position of the object whether it is at infinite or finite directions.

iv) It depends on the position of source of light. If the source of light is kept closer to the object –the shadow will be smaller & if it is Farther then, shadow will be longer.

Factors affecting Lighting:

2. Glare

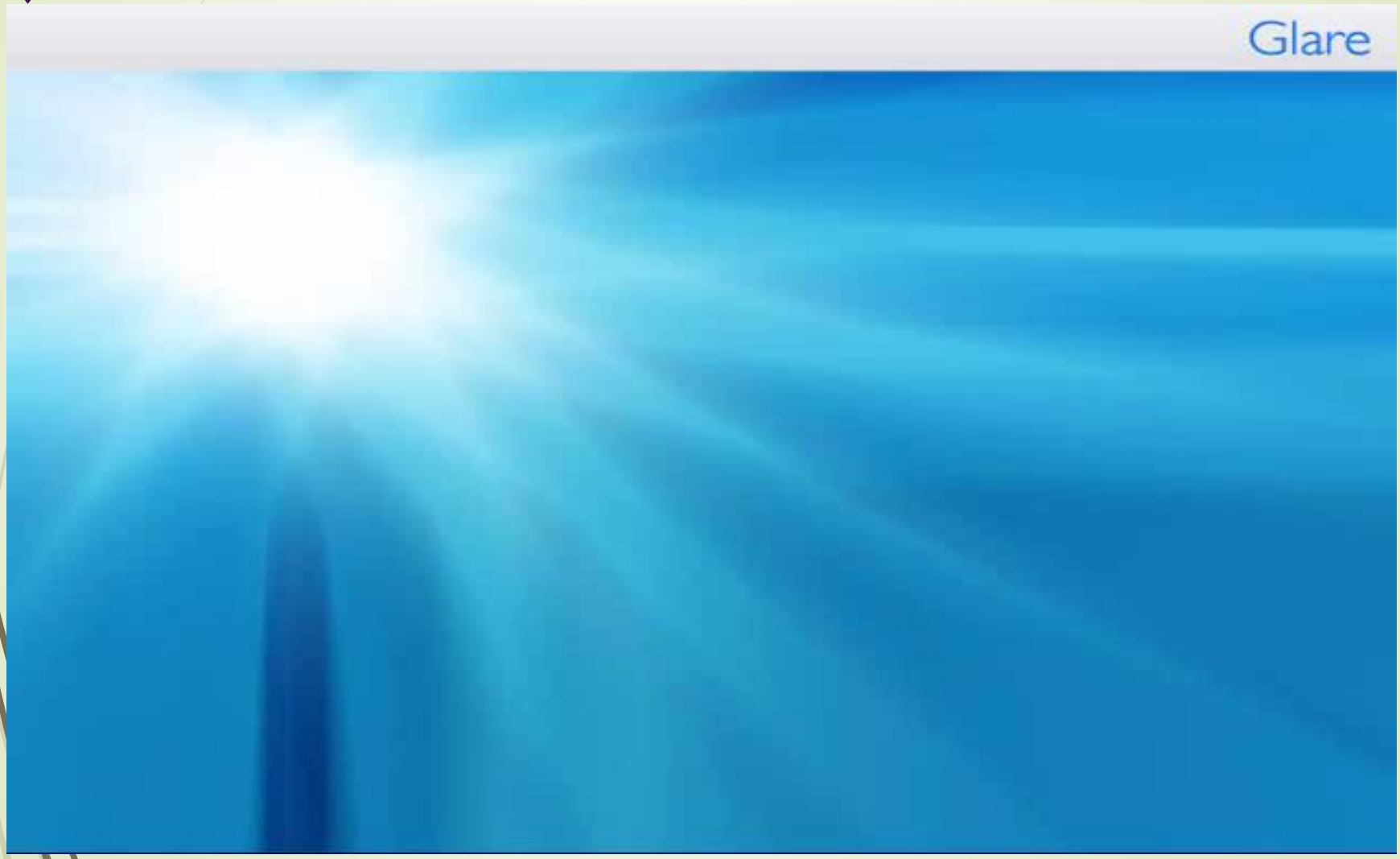
- A Glare is the loss of visual performance or discomfort produced by an intensity of light in the visual field greater than the intensity of light to which the eyes are adapted.
- Glare occurs when too much light enters your eye and interferes with your eye's ability to manage it.
- Glare can be distracting and even dangerous and can occur day or night in a number of ways.
- Glare may come directly from a light source or be reflected.
- *Two types of Glares: Direct /Indirect glare*

i) Discomfort Glare : Results in an instinctive desire to look away from a bright light source or difficulty while seeing a task.

ii) Disability Glare : Caused by inter-reflection of light within the eyeball

Factors affecting Lighting:

- ***2. Glare***

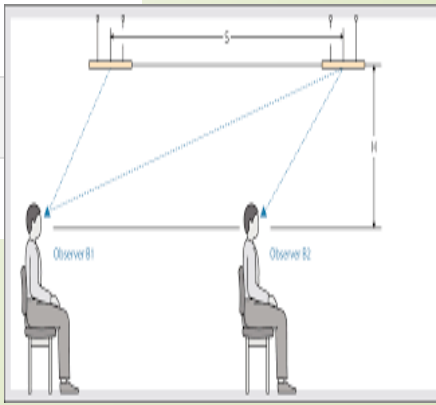


Factors affecting Lighting:

2. Glare…

- UGR: UGR (Unified Glare Rating) is a method of calculating glare from luminaires, light through windows and bright light sources.
- The UGR rating helps to determine how likely a luminaire is to cause discomfort to those around it. For example, the discomfort that a LED Panel will cause the workforce within an office. This classification ranges from 5 to 40, with low numbers indicating low glare.

UGR ≤ 16	Technical drawing
UGR ≤ 19	Reading, writing, training, meetings, computer-based work
UGR ≤ 22	Craft and light industries
UGR ≤ 25	Heavy industry
UGR ≤ 28	Railway platforms, foyers

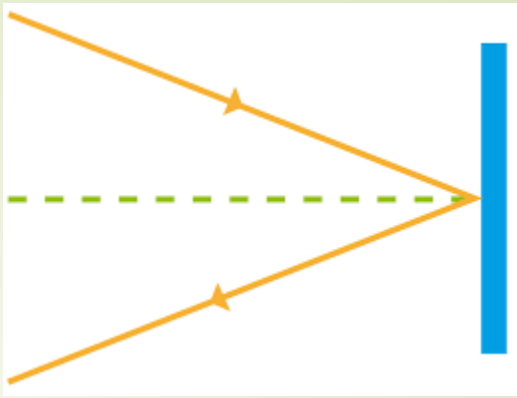


Factors affecting Lighting:

2. Glare:

- VCP: Visual comfort probability (VCP), also known as Guth Visual Comfort Probability, is a metric used to rate lighting scenes.
- It is defined as the percentage of people that will find a certain scene (viewpoint and direction) comfortable with regard to visual glare.
- If VCP = 70%, then system is said to be glare fee.

Factors affecting Lighting:

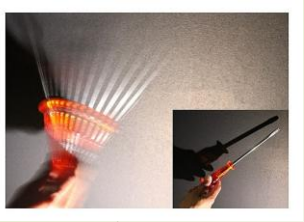


3. REFLECTION:

- When a ray of light approaches a smooth polished surface and the light ray bounces back, it is called the reflection of light.
- The incident light ray which lands upon the surface is said to be reflected off the surface. The ray that bounces back is called the reflected ray.
- **Reflection factor:**
  The ratio of the total amount of radiation, as of light, reflected by a surface to the total amount of radiation incident on the surface.

Aluminum polished:	65 – 75
Granite	20 – 25
Marble, polished	30 – 70
Plaster, light	40 – 45
Plywood, rough	25 – 40
Concrete, rough	20 – 30
Brick, red	10 – 15
Paint, white	75 – 85

Factors affecting Lighting:



4. Stroboscopic Effect:

- The **Stroboscopic Effect in Fluorescent lamp** is a phenomenon which causes running or moving equipment to appear stationary or appear to be operating slower than they actually are.

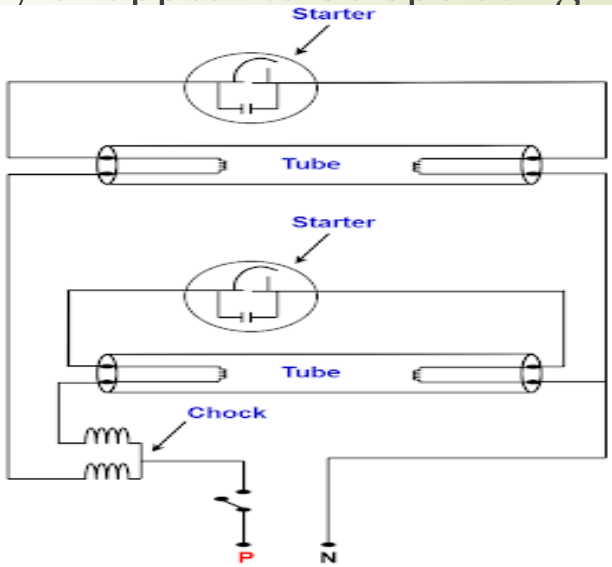
In an AC supply, the voltage drops 100 times a second to zero volts as the supply frequency is 50 Hz. When a Fluorescent lamp is operating with an AC supply, the light intensity drops 100 times a second. This flicker is not noticeable to the human eye due to the persistence of vision.

When a worker in a factory observes a running machine, say a flywheel under the illumination of a fluorescent light, the flywheel may appear to be stationary or to be operating at reduced speed. This can result in accidents and is highly dangerous.

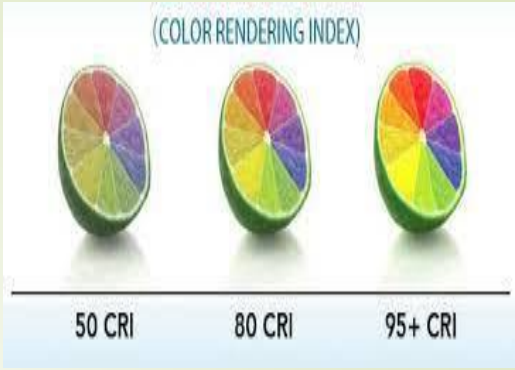
A sewing machine whose needle moves up and down may appear to be stationary and the operator can prick the fingers. These are some examples where the stroboscopic effect in the Fluorescent lamps can prove to be dangerous. When using fluorescent lamps around rotating or moving machinery, two lamps powered by two different phases should be used. This ensures that both the lamps do not flicker due to the zero crossing at the same time.

4. Stroboscopic Effect:

- The **Stroboscopic Effect in Fluorescent lamp** is a phenomenon which causes running or moving equipment to appear stationary or appear to be operating slower than they actually are.
- It can be eliminated by:
- 1) Using 3 phase supply for lighting System
- 2) Using frequency controllers for the supply
- 3) using Twin tubes



- Two lamps are connected parallel to the supply and the lamp is connect in series with a capacitor or choke. Therefore there exist a phase difference between 2 currents.



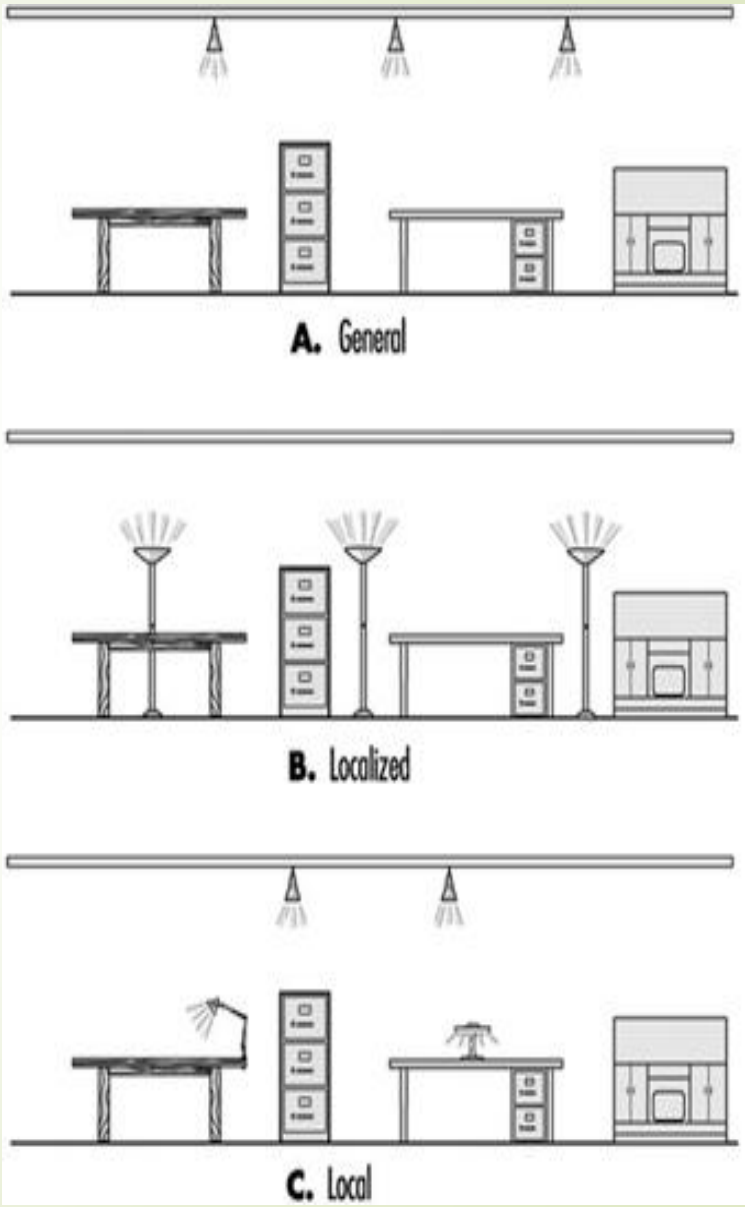
5. Colour Rendering:

- It describes how well the light render color in an object.
- Color Rendering is expressed as a rating from 0-100 on Color Rendering Index (CRI).
- How a light source makes the color of an object appear in human eye and how well the variations in color shades are reveated.
- Color Rendering relates to the object appear under a given light source. This measure is called CRI.
- Low CRI- Object color may appear unnatural
- High CRI- Object color may appear more natural
- Street Lighting- 2.2 (Sodium Vapor Light)
- Office- 62 (Fluorescent Light)
- Residential- 80-90 LED
  95 Incandescent Light
  80-85 CFL

- https://www.khanacademy.org/computing/pixar/rendering/rendering1/v/overview-rendering

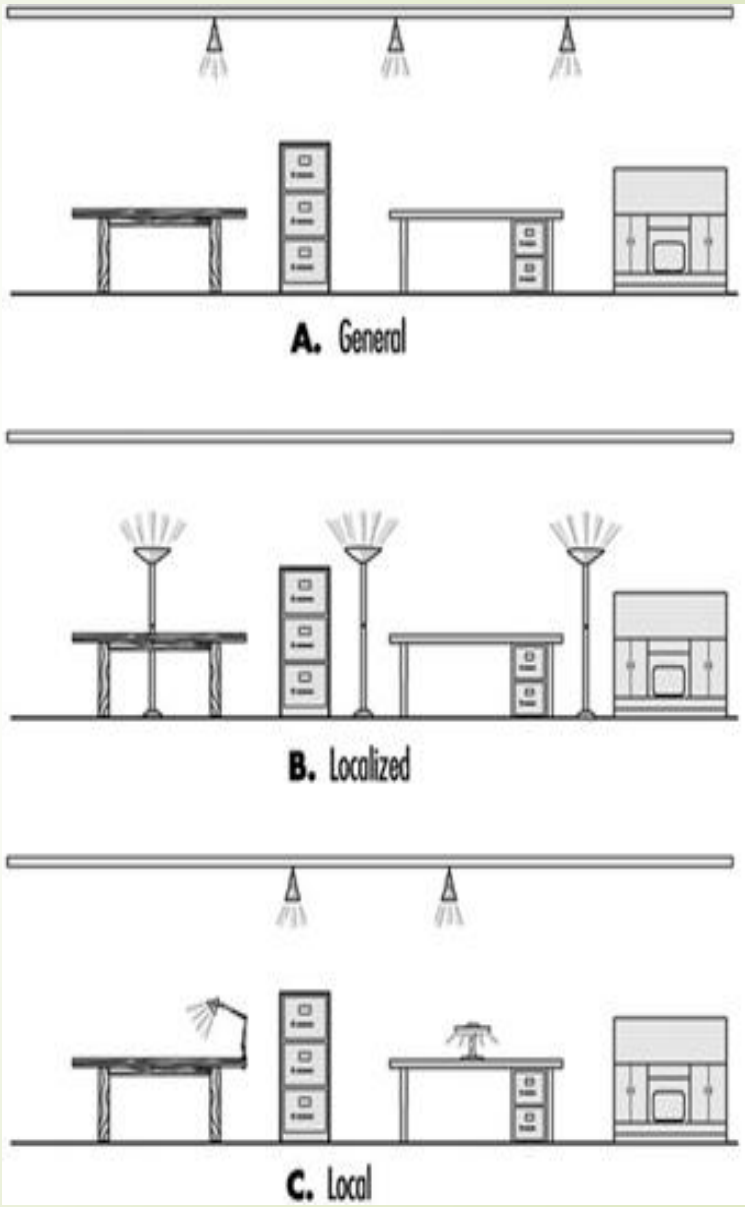
General and Localised Lighting

- The term '***general lighting***' or 'ambient lighting' refers to the background levels of light in a particular space. In the majority of workspaces the minimum level of general lighting is determined in line with best practice guides to ensure safety and enable everyday visual tasks to be performed comfortably and efficiently.
- ***Localized lighting*** systems provide illuminance on general work areas with a simultaneous reduced level of illuminance in adjacent areas.
- ***Local lighting*** systems provide illuminance for relatively small areas incorporating visual tasks. Such systems are normally complemented by a specified level of general lighting. Figure 1 illustrates the typical differences between the systems described.



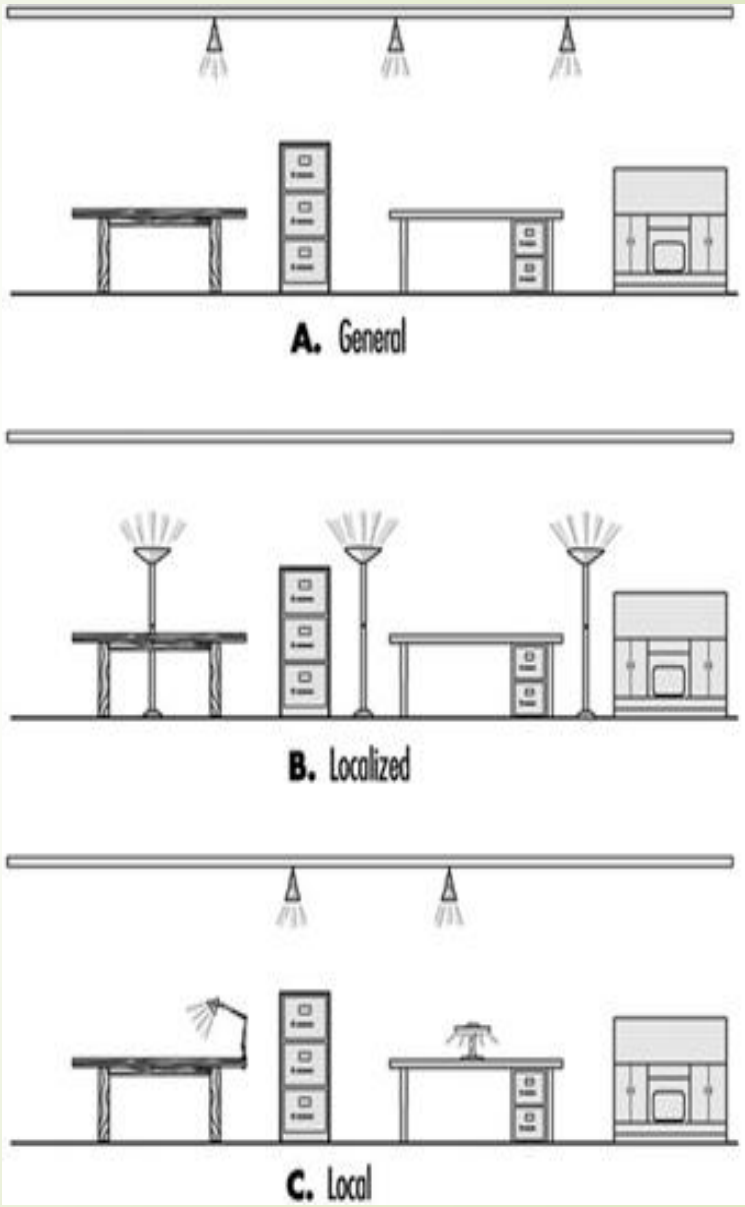
General and Localised Lighting

- '***General lighting***' or 'uniform lighting':
- Lighting system which provides an approximately uniform illuminance on the horizontal working plane over the entire area are called general lighting systems.
- Simple to plan & install
- Adv: It permits complete flexibility of task location
- Disadv: Energy is wasted illuminating the whole area to the level needed only for the most critical tasks.



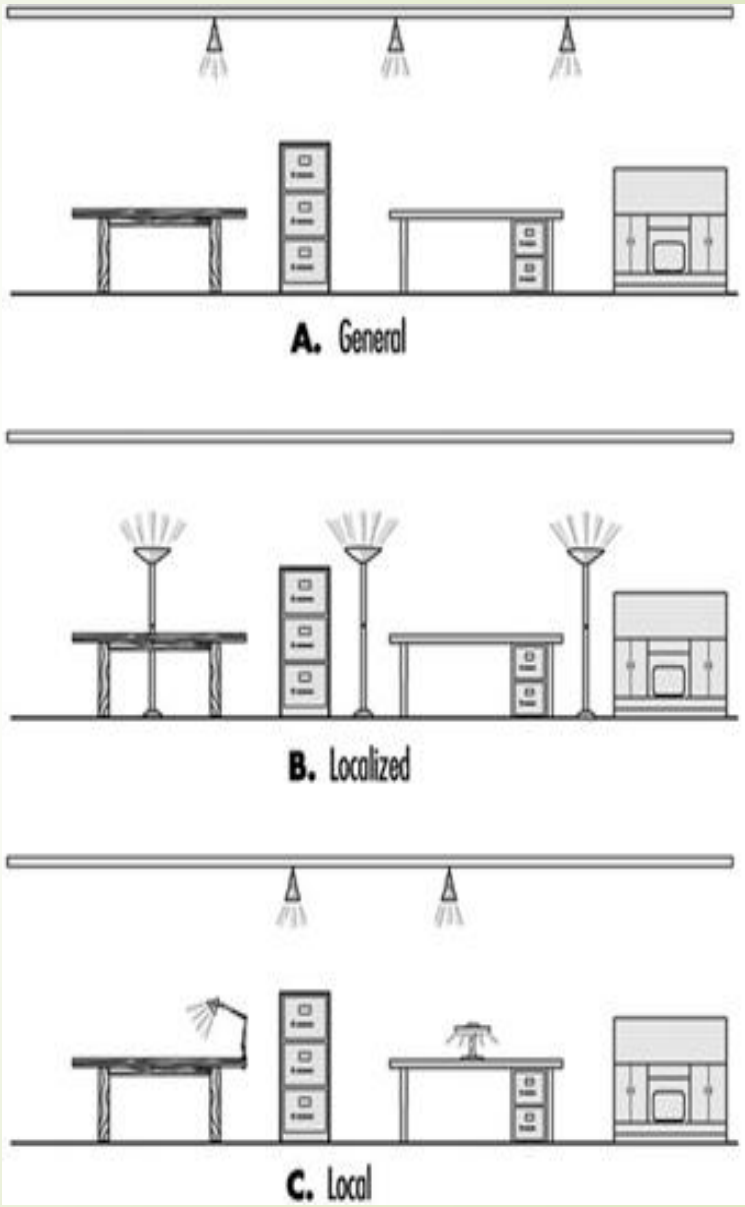
General and Localised Lighting

- ***Localized lighting*** systems
- It employ an arrangement of luminaries related to the position of tasks and workstations.
- They provide the required service illuminance on work areas together itha a lower level ofgeneral illumination for the space.
- Localised systems normally consumes less energy than general systems.



General and Localised Lighting

- ***Local lighting*** systems provides illumination only over the small area occupied by the task and its immediate surroundings.
- Also referred as task ambient lighting
- It is a very efficient system, particularly when high standards of task illuminance are required.
- It is normally provided by luminaires mounted on the workstation, providing a very flexible room layout. Such local units must be positioned carefully to minimize shadows, veiling reflections and glare.



Types of Lamps

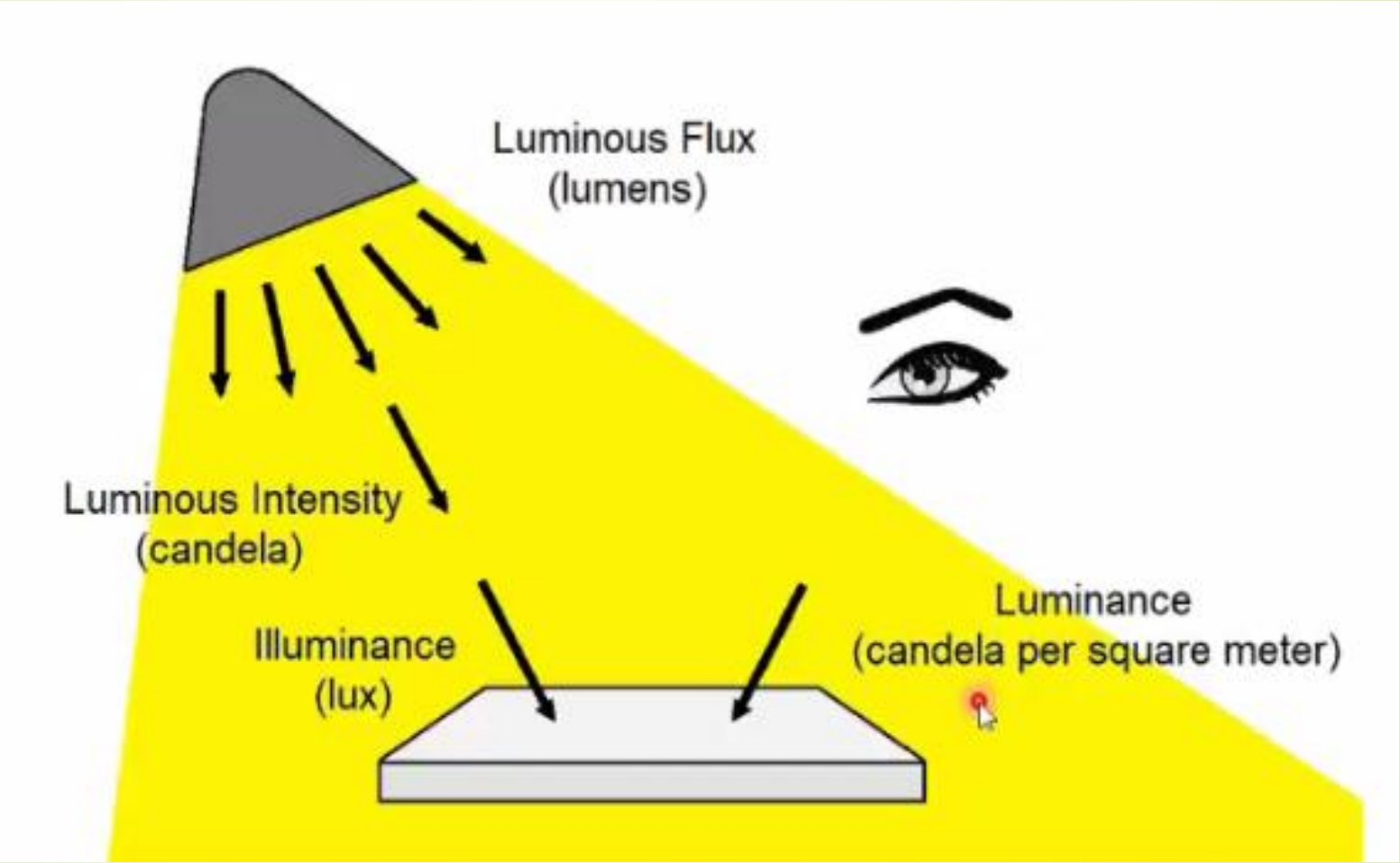
Electric lamps :-

A. Incandescent lamps
B. Discharge lamps

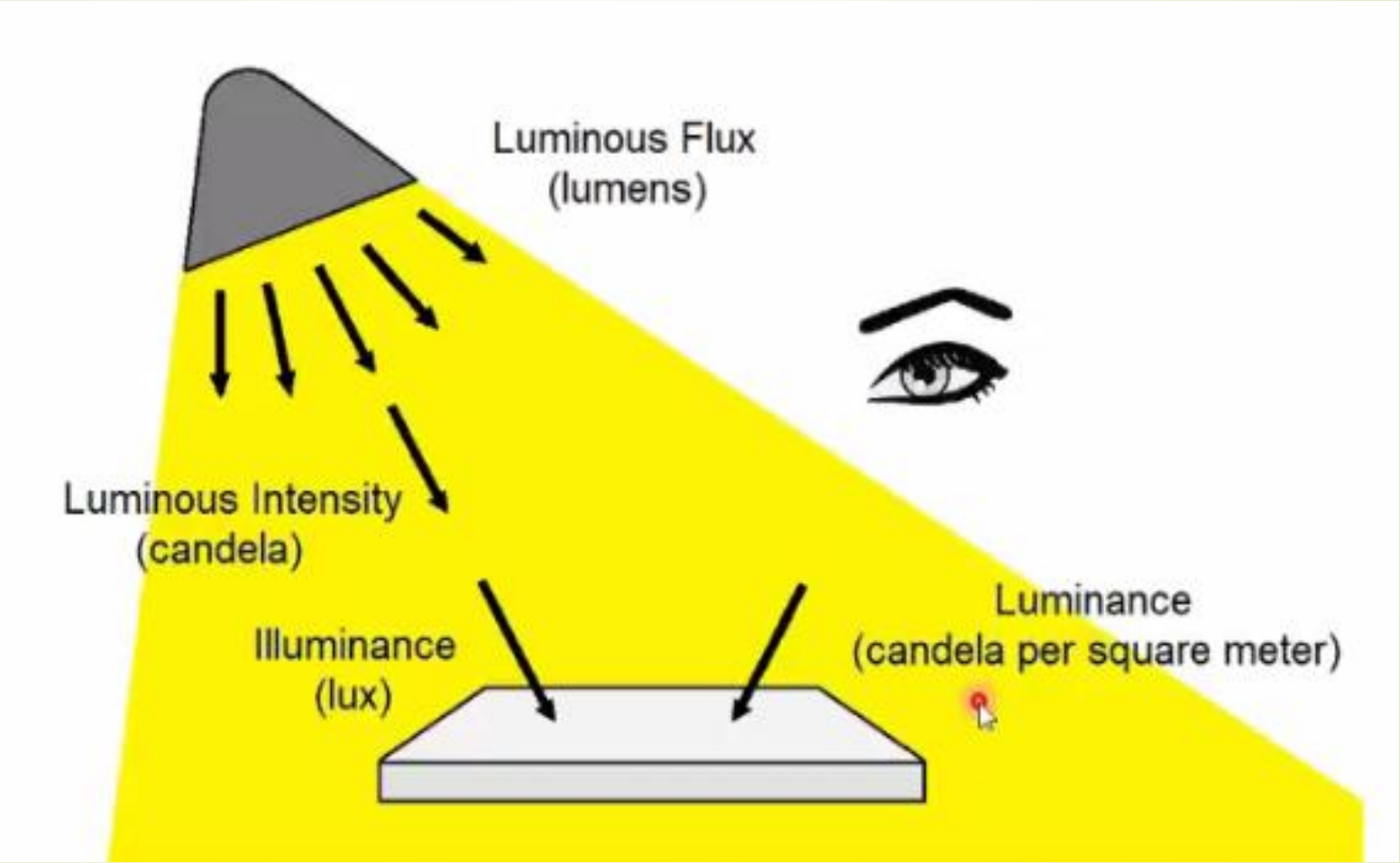
Incandescent lamps:-

1. Vacuum lamps
2. Gas filled lamps

Fundamentals:



Fundamentals / Terms:



- Light:-
  - Electromagnetic energy
  - Radiated from a hot body

- Luminous Flux:-
  - The total quantity of light energy emitted per second
  - Measured in lumens

Conti…

- Luminous Intensity:-
  - Intensity of emission of luminous flux in specific direction.
  - Unit=Candela
- Illumination:-
  - Lights falls on any surface, the phenomenon is called Illumination.
  - Measured in Lumens/m^2

Thank you…