كلية المستقبل الجامعة
قسم الفيزياء الطبية
المرحلة الثالثة

Medical Physics

Lecture 9

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Measurement of Light and Its Units :

Light :

Light or visible light is electromagnetic radiation within the portion of the electromagnetic spectrum that is perceived by the human eye.

Visible light is usually defined as having wavelengths in the range of (400–700) nanometres (nm), corresponding to frequencies of (750-420) terahertz, between the infrared (with longer wavelengths) and the ultraviolet (with shorter wavelengths) .

In physics, the term "light" may refer more broadly to electromagnetic radiation of any wavelength, whether visible or not. In this sense, gamma rays, X-rays, microwaves and radio waves are also light.

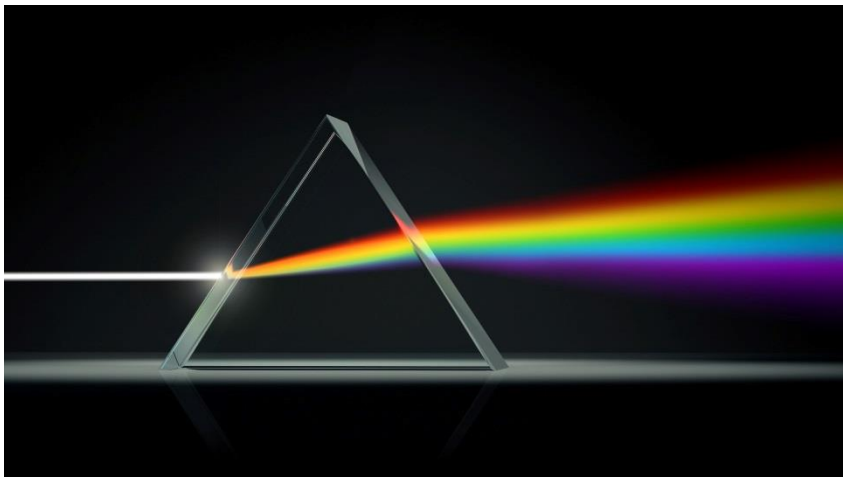
The primary properties of light :

1- intensity

2- propagation direction.

3- frequency or wavelength spectrum and polarization.

Like all types of electromagnetic radiation, visible light propagates by massless elementary particles called photons that represents the quanta of electromagnetic field, and can be analyzed as both waves and particles.



Measurement of Light and Its Units :

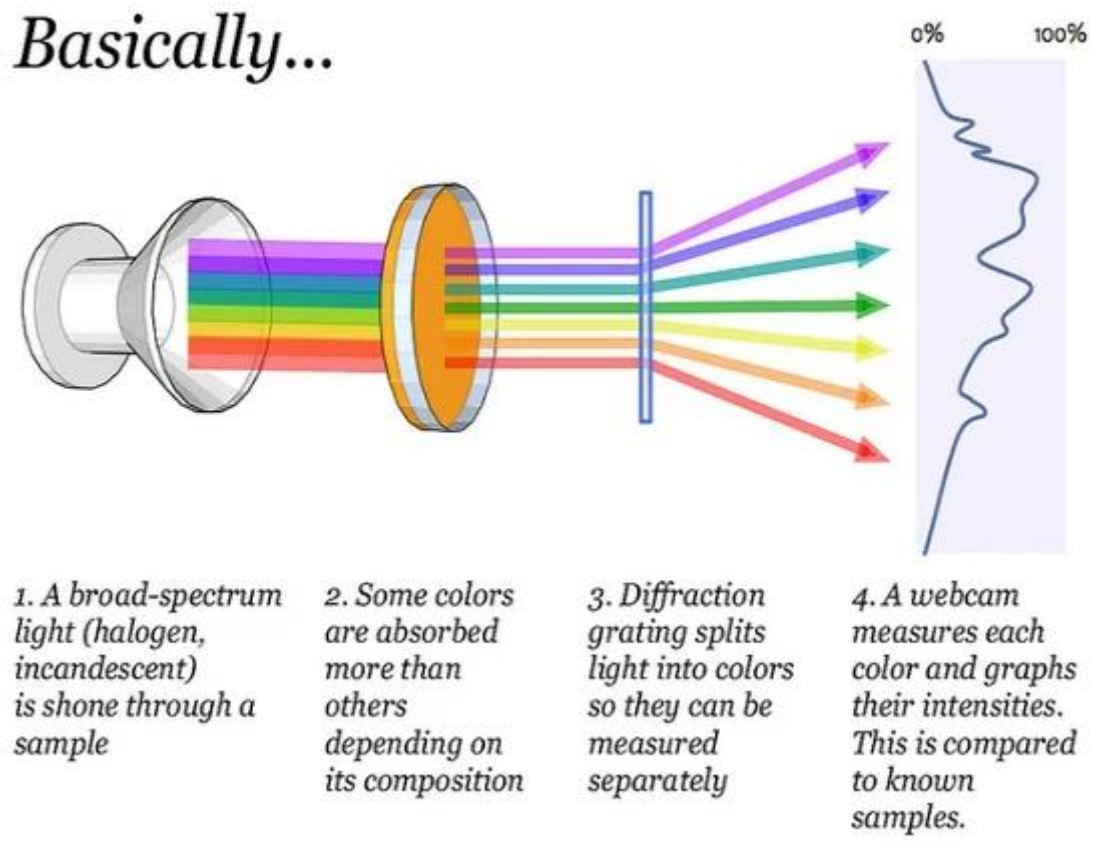
The three general categories of light:

1- Ultraviolet (UV) .

2- Visible Light .

3- Infrared light (IR) .

Are defined in terms of their wavelengths. Wavelengths of light used to be measured in microns (1μ=10-6m) or in angstroms (1Å=10-10 m), but at present the recommended unit is the nanometer (1nm=10-9m). Ultraviolet light has wavelengths from about 100 to 400 nm; visible light extends from about 400 to nm; and IR light extents from about 700 to over 104 nm .



Unit of Light :

The lighting industry uses several different units to measure light, depending on what information is needed .

Below are a few of the most common units and terms :

Flux (Luminous Flux) :

Originating from the Latin word 'Fluxus,' meaning flow, flux is the amount of energy a light emits per second, measured in lumens (lm) .

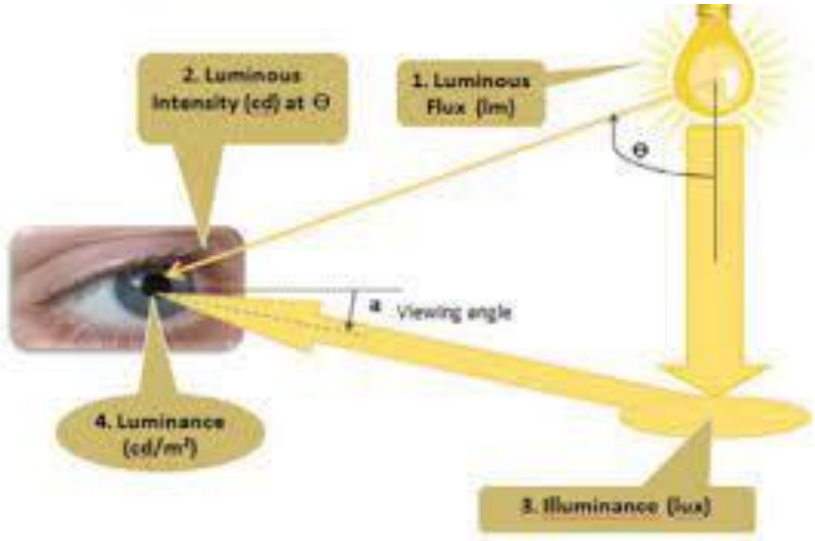
When it comes to lighting, you need to consider watts (W) (energy used) versus lumens (lm) (brightness). Or electricity consumption versus light output. Lumens are weighted for human perception where as watts are not.

- **Lumen (lm) :** The SI unit of luminous flux, this is a unit of light flow

- **Watt (W) :** The unit of measuring electrical power, this is a radiometric measurement .

Common Photometry Applications :

As with radiometry, applications of photometry are also diverse. It is used in a number of industries to test the intensity of light produced by displays, instrument panels, night-vision devices and more .



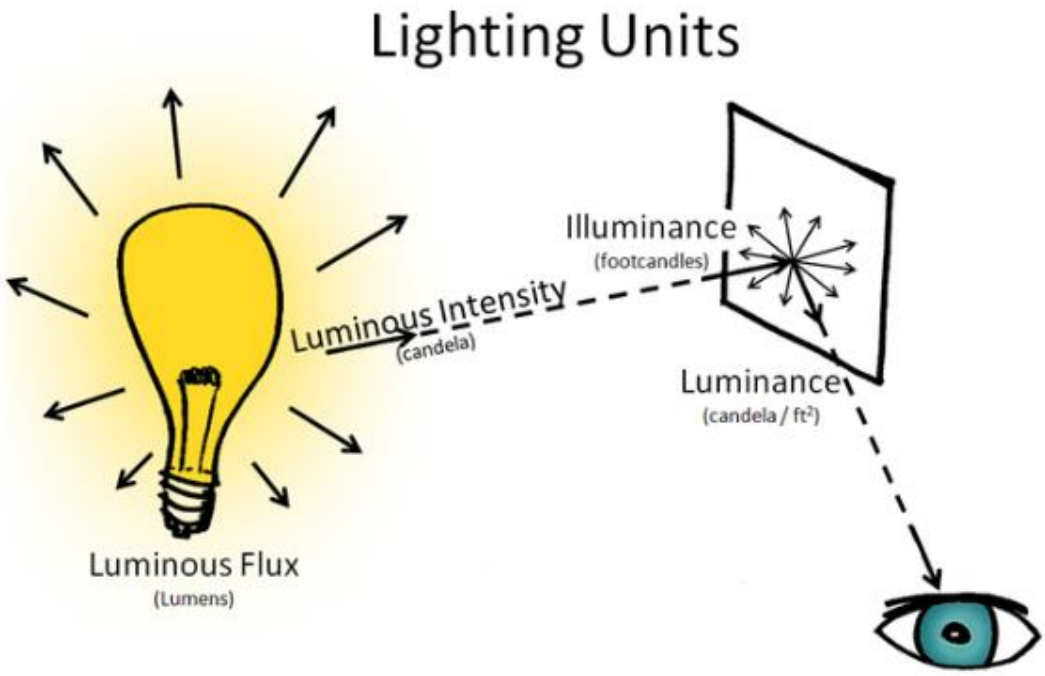
The basic unit of photometry is the lumen. Photometry consists of four basic concepts :

1- Luminous flux : Measured in lumens, luminous flux is the measurement of total perceived power emitted in all directions by a light source .

2- Luminous intensity : Measured in candela, luminous intensity is the amount of light emitted by a source in a particular direction

3- Illuminance : Measured in lumens per unit area, illuminance refers to the amount of light incident on a surface. Illuminance can also be referred to in foot-candle.

4- Luminance - Measured in candela per square meter or nit, luminance is the total light emitted or reflected from a surface in a given direction. It indicates how bright we perceive the result of the interaction of the incident light and the surface .



Applications of Ultraviolet and Infrared Light in Medicine:

-The wavelengths adjacent to the visible spectrum also have important uses in medicine .

-Ultraviolet photons have energies greater than visible photons, while IR photons have lower energies. Because of their higher energies, UV photons are more useful than IR photons .

-Ultraviolet light with wavelengths below about 290nm is germicidal-that is, it can kill germs-and it is sometimes used to sterilize medical instruments. Ultraviolet light also produces more reactions in the skin than visible light .

-Some of these reactions are beneficial, and some are harmful. One of the major beneficial effects of UV light from the sun is the conversion of molecular products in the skin into vitamin D. Dermatologists have also found that UV light improves certain skin conditions .