Islamic Republic of Afghanistan

Ministry of Higher Education

Sayed Jamaludine Afghani University

Computer science Faculty

Software Engineering Department

IT/information Technology Department

Subject: Physics

Teacher: Tariq Aziz

Credit: (4)

Lecture one

Prepared By Said Agha Sadiq

Subject :-

PHYSICS-II

Dept :-

COMPUTER SCIENCE

Reference Book :-

ⓐ Physics of Light and Optics
by :-
Justin Peatross &
Michael Ware

ⓑ Introduction to Modern Optics
by :-
Grant R. Fowles

→ Basic Characteristics of Light

⇒ Light :-

↳ Light is a form of energy (electromagnetic radiation) which is given by luminous objects.

→ The sun, bulb, candle etc are luminous objects.
→ Other objects which don't give out light are called non-luminous objects.

→ Effects of Materials on Light :-

↳ Materials can be classified based on how it responds to light incident on them.

① Opaque Materials :-
↳ absorb light, don't let light to pass through them.

② Transparent Materials :-
↳ allow light to easily pass through them.

③ Translucent Materials :-
↳ allow light to pass through them but distorts the light during the passage.

→ Speed of Light :-
↳ The energy of light is given by :-

$$E = fh$$

& $$f = \frac{c}{\lambda}$$

$$\therefore \quad E = \frac{hc}{\lambda}$$

Similarly :

$$c = \frac{\lambda E}{h} = f\lambda$$

Where :-

$c = 299,792,458$ m/s is the speed of light in vaccum.

h = plank's Constant and its value is $6.626070\,15 \times 10^{-34}$ j.s or $4.135\,667\,696 \times 10^{-15}$ eV.s

E = energy

λ = Wavelength.

→ Note that the frequency of vibration (f) remains constant when the light passes through a substance but only wavelength (λ) decreases, due to which the velocity (c) is reduced.

→ Generally, Refractive index varies linearly with wavelength (λ).

→ Refractive Index :-

↳ Refractive index of a material is defined as "The ratio of the speed of light in a vaccum (C) to the speed of light in a material through which it passes (C_m).

$$n = \frac{C}{C_m}$$

Note that the value of refractive index will always be greater than 1, Since C_m can never

be greater than c.

→ In general, c_m depends on the density of the material, with c_m decreasing with increasing density.

→ Thus, higher density materials will will have higher refactive indices.

→ Materials can be divided into two classes based on how the velocity of light of a particular wavelength varies in the material.

① Isotropic Materials :-
↳ Materials whose refractive index not depend on the direction that the light travels are called isotropic materials.

→ Isotropic materials have a single, constant refractive index for each wavelength.

e.g :- Glass, gases, most liquids etc are isotropic.

② An-isotropic Materials :-
↳ Materials whose refractive index depend on the direction

that the light travels are called anisotropic materials.

→ These types of materials will have a range of refractive indices b/w two extreme values for each wavelength.

→ Nature Of Light :-

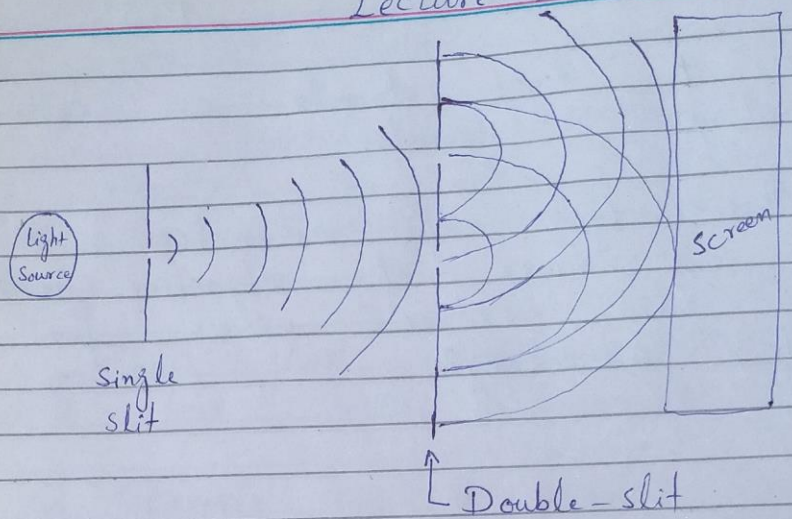
↳ Light has dual nature. Depending on the phenomenon or behavior, light can be treated either as a wave or as a particle.

To examine this wave-particle duality, we will examine two experimental proofs.

① Young's Double-Slit Experiment :-

→ Describe wave nature of light, provided an experimental basis for considering light as a wave.

→ Conducted by Thomas Young, in the early 1800's.



Key-Points of Young's Experiment :-

① The individual slit acted as individual sources which light passes through and spreads. (Isn't this like, water waves?)

② Light exhibits interference which is a wave property.

② The Photoelectric Effect :-

→ Explained by Einstein during the early 1900's.

→ Provided an experimental basis

for considering light as a particle.

→ Key Points of Photoelectric Effect :-

① Higher energy light knocks off electrons at higher energy.

② The number of ejected electrons is directly related to the intensity (brightness) of light. This means brighter lights emit more photons.

③ Light is a particle since it is capable of "knocking off" electrons.

Further, unlike waves, increasing the brightness does not increase the energy of the knocked off electrons.

→ Basic Properties of Light :-

① Reflection Of Light :-

Def :- The process through which light rays falling on the surface of an object are sent back (bounces off) is called reflection of light.

→ The objects having shiny or polished surface reflects more light compared to the objects having dull or unpolished or rough surface.

→ Silver metal is the best reflector of light. That's why plane mirror is made by depositing a thin layer of silver metal on one side of a plane glass sheet.

→ Types of Reflection :-

Reflection

ⓐ Regular / Specular Reflection

ⓑ Diffuse Reflection

ⓐ Regular / Specular Reflection :-

In regular reflection, a parallel beam of incident light is reflected as a parallel beam in one direction, and it occurs from smooth surfaces like that of a plane mirror or highly polished metal surfaces.

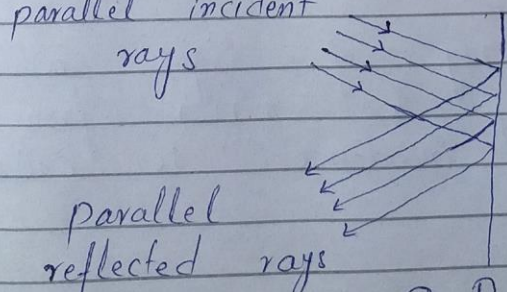
ⓑ Diffuse Reflection :-

In diffuse reflection, a parallel beam of incident light is reflected in different directions.

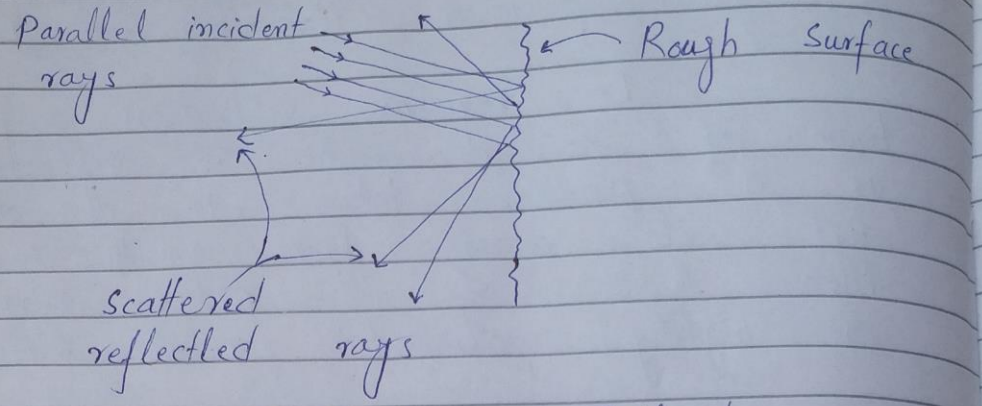
In this case, the parallel incident light rays don't remain parallel after reflection but scattered in different directions.

→ Also known as irregular reflection.

See the Figures :-



ⓐ Regular Reflection



(b) Diffuse Reflection

Important Terms :-

(i) Incident ray :-
The ray of light falling on the surface of a mirror is called incident ray.

(ii) Point of incidence :-
The point at which the incident ray falls on the mirror surface is called point of incidence.

(iii) Reflected ray :-
The ray of light which is sent back by the mirror from the point of incidence is called reflected ray.

(iv) Normal :-
A line Perpendicular or at the right angle to the mirror surface at the point of incidence is called normal.

(v) Angle of incidence :-
The angle made by the incident ray with the normal is called angle of incidence.

(vi) Angle of Reflection :-
The angle made by the reflected ray with the normal at point of incidence is called angle of reflection.

→ Laws of Reflection :-

ⓐ First law of reflection :-

According to the first law :-
"The incident ray, reflected ray and normal, all lie in the same plane".

(b) Second Law of Reflection:

According to the second law, "The angle of reflection is always equal to the angle of incidence".