VESP Vision

To be the centre of excellence in the field of technical education.

Program Code:-Common to all 1st semester

Course Name:-Basic Science(Physics)

Course Code : - 22102

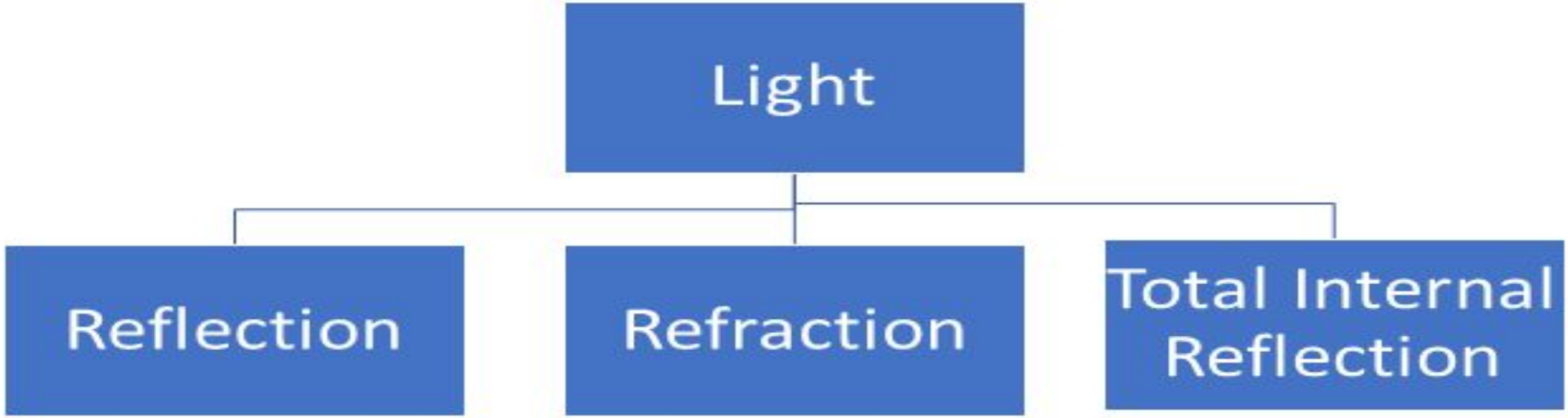
Course coordinator: Mrs. Deepa Gupte

Date: 12/07/2020

Unit No:3
Unit Name: Heat and Optics

Unit Outcomes (UO3e):Distinguish the phenomena of total internal refection for the given media.
Learning Outcome (LO5) : Students will be able to explain reflection, refraction and total internal reflection.

Concept Map

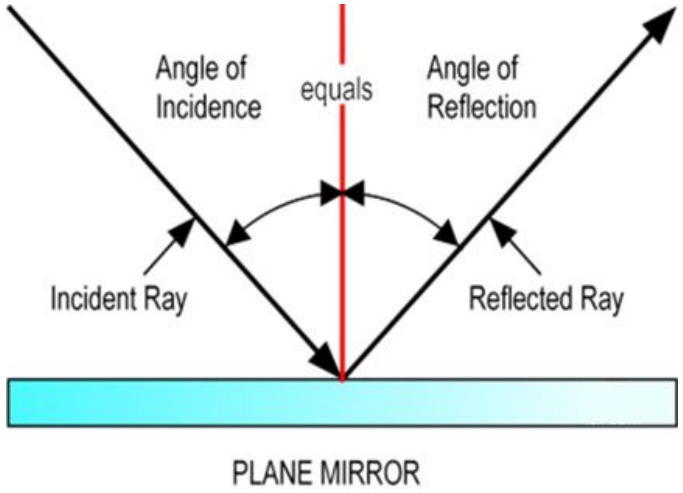


Learning Objective/ Key learning

- Students will be able to explain reflection and laws of reflection
- Students will be able to explain refraction and laws of refraction .
- Students will be able to explain total internal reflection

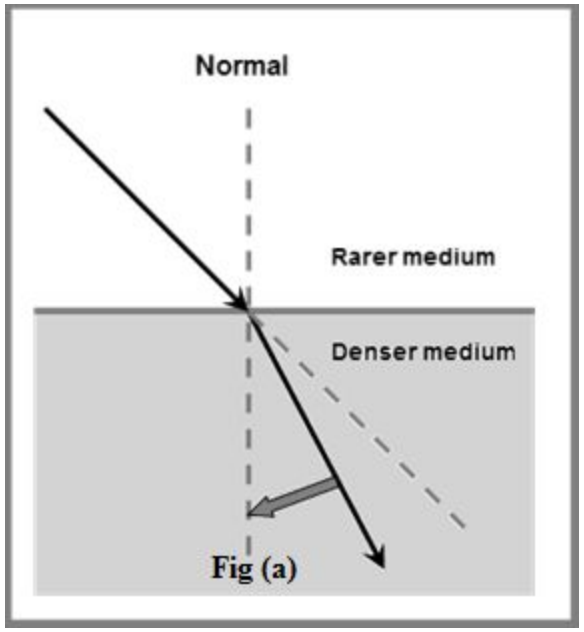
Reflection of light

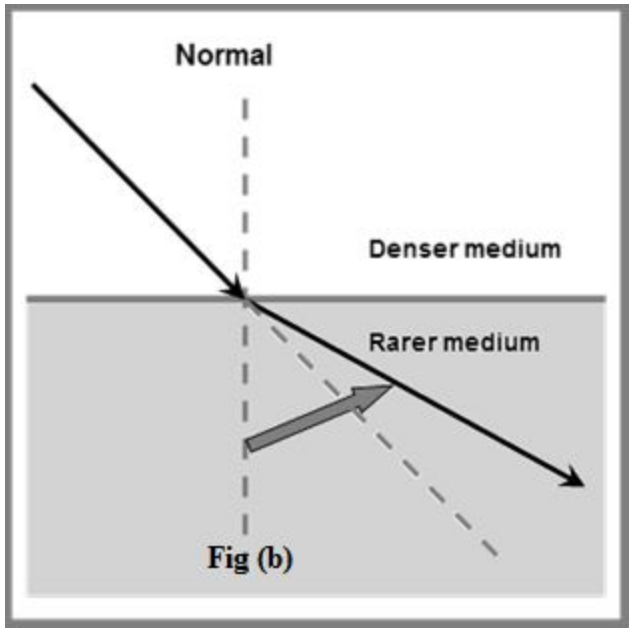
- When light falls on a highly polished surface like a mirror most of the light is sent back into the same medium. This process is called reflection of light.
- <u>Laws of reflection of light</u> :-
    - The angle of incidence is equal to the angle of reflection.
    - The incident ray, the reflected ray and the normal to the mirror at the point of incidence all lie in the same plane.



Refraction of light

- When light travels obliquely from one transparent medium into another it gets bent. This bending of light is called refraction of light.
- When light travels from a rarer medium to a denser medium, it bends towards the normal.
- When light travels from a denser medium to a rarer medium to a rarer medium, it bends away from the normal.





Laws of Refraction

- The two laws of refraction are:
  - The incident ray, the refracted ray and the normal to the surface of separation of two media lies in one plane.
  - For any two media, the ratio of the sine of angle of incidence to the sine of angle of refraction is a constant

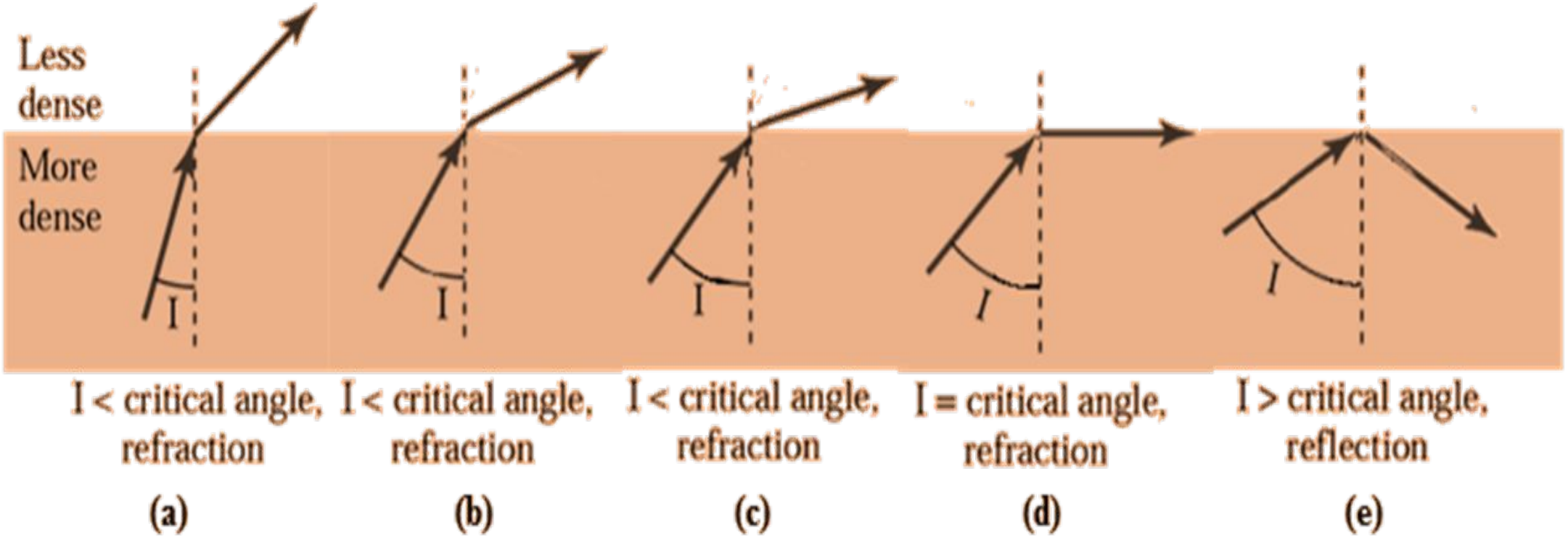
Snell's Law

- The constant is called refractive index of second medium with respect to first medium. For a given pair of media, refractive index is written as $\frac{\sin i}{\sin r} = \mu_{12} = \frac{\mu_1}{\mu_2}$
- If the light passes from first medium to second medium, then the refractive index of first medium with respect to second medium is written as $\frac{\sin i}{\sin r} = \mu_{12} = \frac{\mu_1}{\mu_2}$
- **This law is known as Snell's law.**

Total Internal Reflection (T.I.R.)

- When a ray light passes from an optically denser medium into an optically rarer medium, the refracted ray is bent away from the normal.
- It is obvious that the angle of refraction is always greater than the angle of incidence and its value increases as the angle of incidence increases .
- A stage reaches when for a certain angle of incidence i_c called the critical angle, the angle of refraction is 90^0, thus the ray instead of being refracted is totally reflected back in a denser medium.

Total Internal Reflection (T.I.R.)



Conditions of T.I.R:

- **Principle of T.I.R:** When a ray light passing from a denser medium to a rarer medium at an angle greater than the critical angle, the ray gets totally reflected in a denser medium. This phenomenon is called the total internal reflection (T.I.R)
- **Conditions of T.I.R:**
  - The ray of light must travel from an optically denser medium into an optically rarer medium.
  - The angle of incidence in the denser medium should be greater than the critical angle for a given pair of media.

Critical Angle

- When a light ray passes from a denser medium to a rarer medium, the angle of incidence at which the angle of refraction is 90°, is called critical angle.
- We know, if $r = 90°$ at $i = i_c$, then $\mu_{21} = \frac{\mu_2}{\mu_1} = \frac{\sin i_c}{\sin 90°}$
- Let for optically denser medium $\mu_1 = \mu$ and for air $\mu_2 = 1$.
- $\therefore \quad \frac{1}{\mu} = \frac{\sin(i_c)}{1} \quad \Rightarrow \quad \sin(i_c) = \frac{1}{\mu} \quad \Rightarrow \quad i_c = \sin^{-1}\left(\frac{1}{\mu}\right)$
- Thus the above equation is used to find critical angle provided the refractive index of denser medium is known

Critical Angle

- Similarly for two different media, the critical angle is calculated as

$$i_c = \sin^{-1}\left(\frac{\mu_1}{\mu_2}\right)$$

where μ_1 and μ_2 are the refractive index of the rarer and the denser medium respectively