



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

1

UNIT 4 – OPTICAL COMMUNICATION

**TOPIC – OPTICAL FIBERS AND DEVICES-ACCEPTANCE ANGLE, NUMERICAL
APERTURE**



RAY THEORY TRANSMISSION

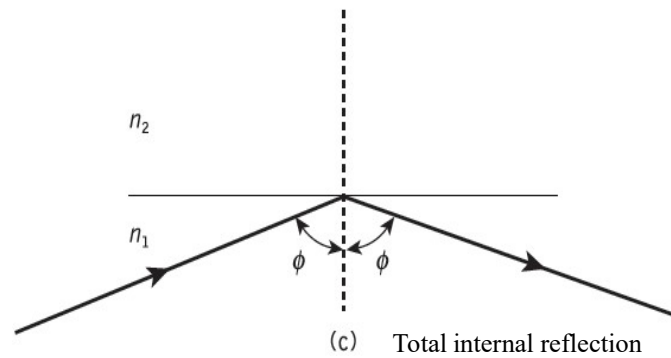
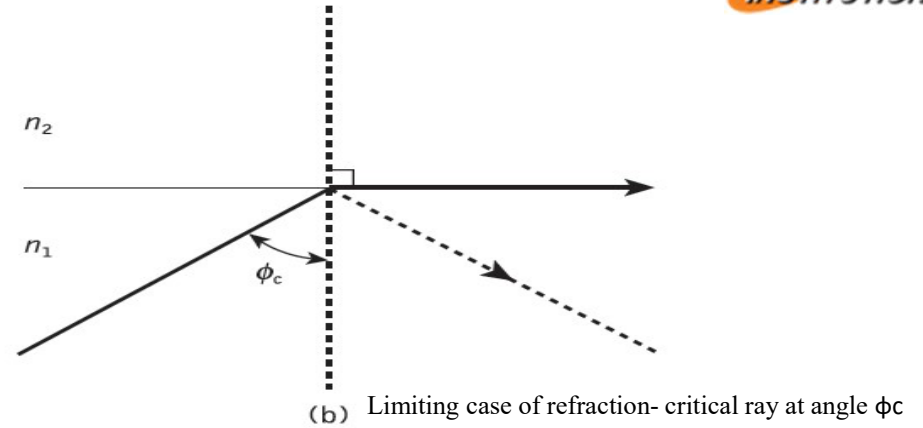
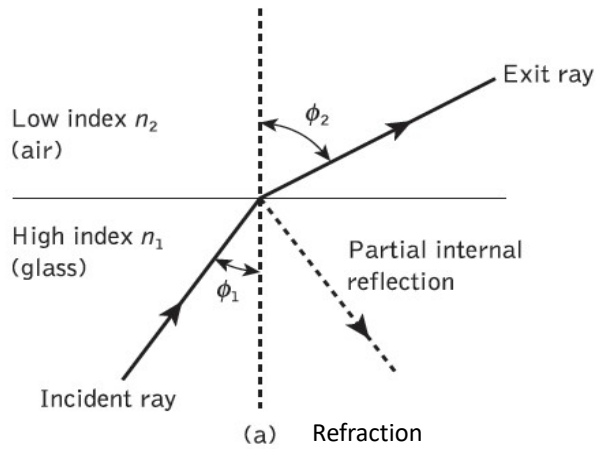


Total internal reflection

▪ Refraction

- When a ray is incident on the interface between two dielectrics of differing refractive indices (e.g. glass – air) refraction occurs shown in Fig. a.
- The angle of incidence ϕ_1 and angle of refraction ϕ_2 is related by Snell's law of refraction
$$n_1 \sin\phi_1 = n_2 \sin\phi_2 \text{ (or)}$$

Refractive index of a medium = Velocity of light in a medium/ Velocity of light in a vacuum





- Critical angle
- As n_1 is greater than n_2 , the angle of refraction is always greater than the angle of incidence.
- Thus when the angle of refraction is 90° and the refracted ray emerges parallel to the interface between the dielectrics, the angle of incidence must be less than 90° . This is the limiting case of refraction and the angle of incidence is now known as the critical angle ϕ_c (Fig. b),

$$\sin \phi_c = \frac{n_2}{n_1}$$

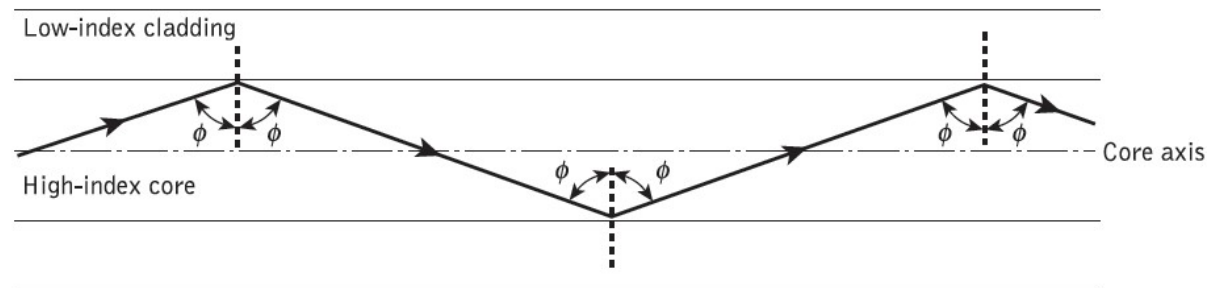
- Total internal reflection
- When light is incident on the dielectric of lower index from the dielectric of higher index at angles of incidence greater than critical angle. (Fig. c)



Propagation of light wave through Optical fiber



- Any light wave which travels along the core and meets the cladding at the critical angle of incidence will be totally internally reflected. Therefore light wave is propagated along the fiber core by a series of total internal reflections.





ACTIVITY TIME



$2 \times 2 \times 1 = 16$

$3 \times 3 \times 3 = 27$

$2 \times 2 = 12$

$1 + 2 \times 3 = ?$

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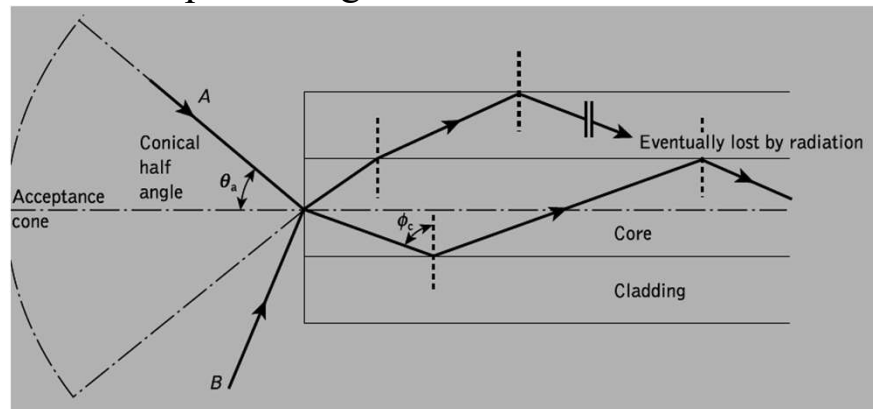


Acceptance angle



Acceptance angle

- ✓ Meridional ray A enters the fiber core at an angle θ_a .
- ✓ Incident ray b at an angle greater than θ_a is refracted into the cladding and eventually lost by radiation.
- ✓ An acceptance angle defined by the conical half angle θ_a .
- ✓ θ_a is the maximum angle to the axis at which light may enter the fiber in order to be propagated is called acceptance angle for the fiber.





Numerical Aperture (NA)

✓ Numerical aperture of the fiber is the light collecting efficiency of the fiber and is the measure of the amount of light rays that can be accepted by the fiber.

It is equal to the sine of acceptance.

$$NA = n_0 \sin \theta_a = (n_1^2 - n_2^2)^{1/2}$$

where, n_1 and n_2 are the refractive indices of core and cladding respectively.

✓ Numerical aperture of step index fiber is given as


$$NA = n_1 \sqrt{2\Delta}$$



ASSESSMENT TIME



Think, Pair, Share

What's the issue/ question/ topic?	What do I think about it?	What does my partner think?	What will we share?
			



THANK YOU