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Q1

A = Why Fiber-optic communication? Explain in detail the basic blocks of fiber optic

B.

Ans:- • Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fiber. The light forms an electromagnetic carrier wave that is modulated to carry information.

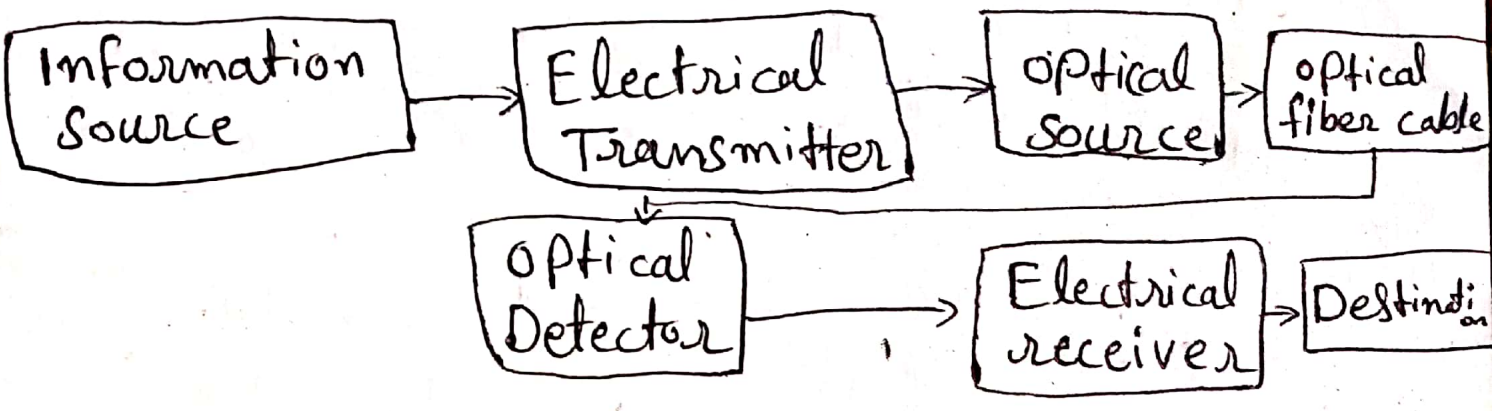
• Optical Fibre:-

An optical fiber wave guide is normally cylindrical in form.

• Function:-

It confines electro magnetic energy in the form of light to within its surfaces and guides the light in a direction parallel to its axis.

Block diagram of the optical fiber communication system.



Q 1 B | Describe and differentiate between LED and LD. Explain its principle of action and types of LD.

Ans
- LED stands for Light Emitting Diode
- LED is semiconductor device that produces infrared lights when electric current is applied to the device.
- this process is also called Electroluminescence

- Laser Diode

⇒ The region where there is more stimulated emission than absorption results in optical gain.

⇒ optical gain depends upon the photon energy and thus wavelength (see density of States)

Difference between an LD and LED

Laser Diode

- Stimulated radiation
- narrow linewidth
- coherent
- higher output power
- a threshoid device
- Stroong temperature dependence
- higher coupling efficiency to a fiber

LED

- spontaneous radiation
- broad spactral
- incoherent
- lower output power
- no threshold current
- weak temperature dependence
- lower coupling efficiency

Q.2 A

Explain the phenomena of total internal Reflection. support your answer with the help of diagram.

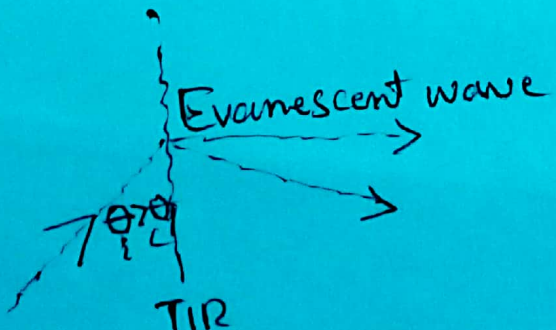
Ans: Total Internal Reflection

- when $\theta_i > \theta_c$

→ there is no transmitted wave but only a reflected wave

- This phenomena is called total internal reflection.
- TIR Phenomenon leads to th Propagation of wave in a dielectric medium surrounded by a medium of smaller refractive indexe.

-Ex: optical fibers



TIR

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

Q.2 B What is cable-loss factor? Explain the relation $P_{out} = P_{in} \times 10^{-AL/10}$

Ans 1) Microbending

2) Macrobending

3) Scattering

4) Absorption

relation :-

$$P_{out} = P_{in}\, 10^{-AL/10}$$

$$A\ (dB/km) = \frac{-10 \log_{10} \left(\frac{P_{out}}{P_{in}}\right)}{L\ (km)}$$

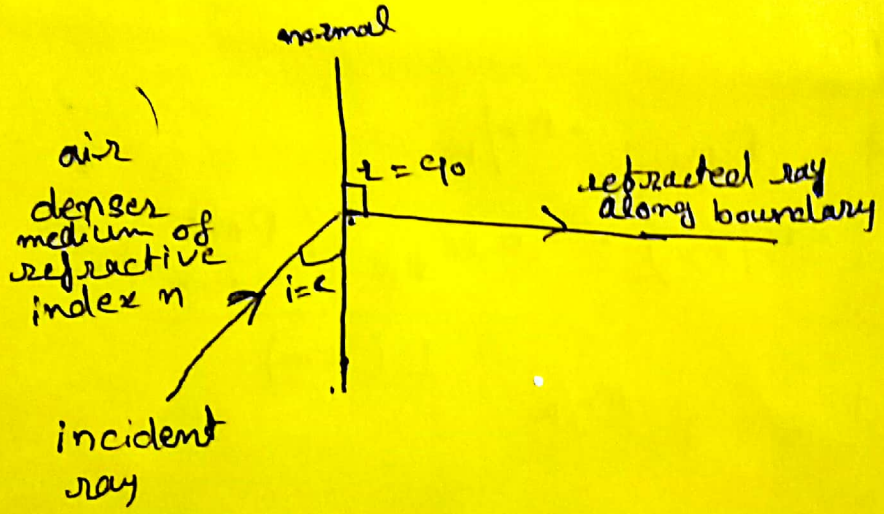
$$\frac{P_{out}}{P_{in}} = 10^{-AL/10}$$

$$P_{out} = P_{in}\, 10^{-AL/10}$$

Q.3 a critical incident angle, Show ciritical incident angle using figure ?

Ans :- Critical Angle

- the critical angle is defined as the angle of incidence in the optically denser medium for wich the angle of refraction in the optially less dense medium is 90°.



b) Critical Propagation angle, also explain why is critical propagation angle so importand

Critical Angle of Propagation:

- consider a step index optical fiber into wich light is Launched at one end. the end at which light enters the fiber is called Launching end.

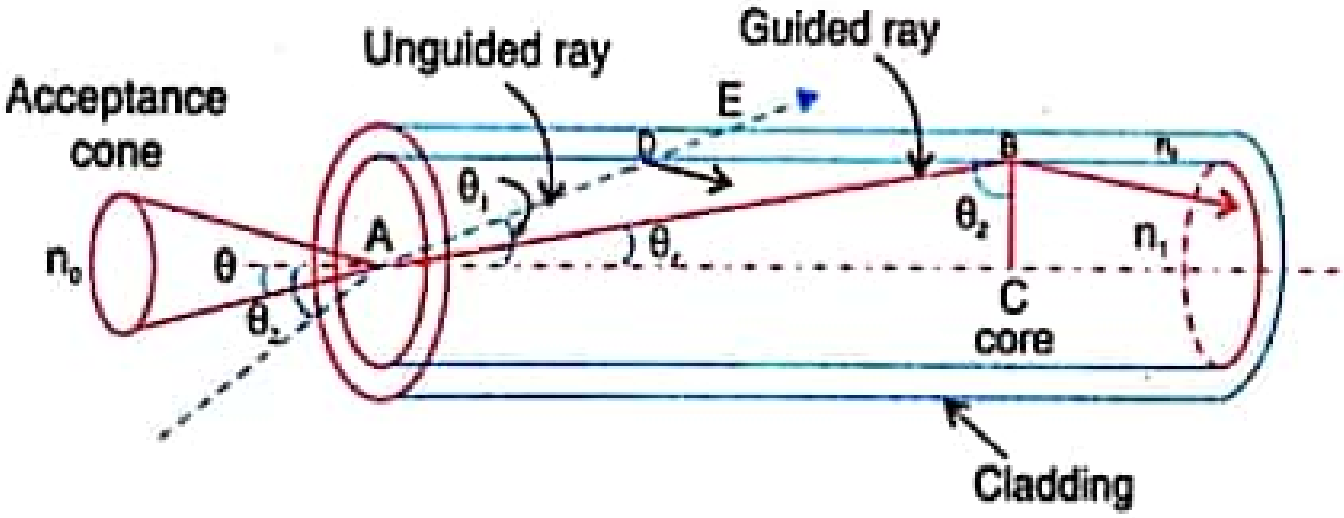
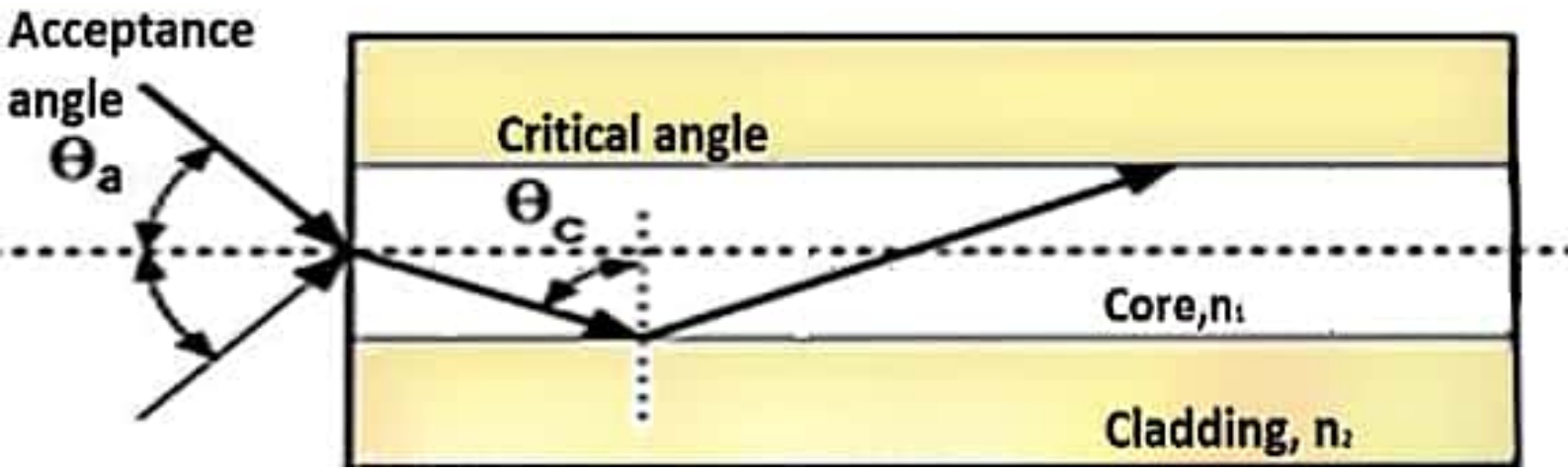


Figure : (7)

c) Acceptance angle What is the relation between spatial angle and acceptance angle?

A). The maximum angle with in which light will be accepted by an element, such as a detector or wave guide.

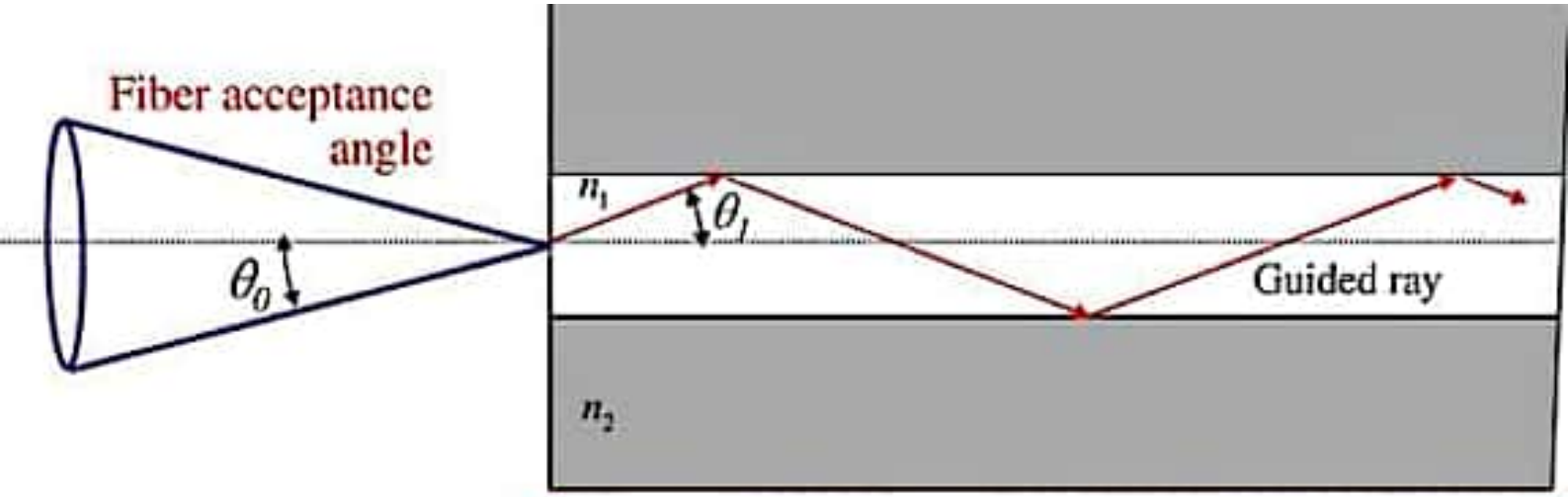
- In the latter, it is quantified as half the vertex angle of the cone within which optical power may be coupled into bound modes of a fiber. Also called acceptance cone.



d) Numerical Aperture and explain the relation $\theta_{1c} \rightarrow \alpha_c \rightarrow \theta_a \rightarrow NA$

A) Numerical Aperture :-

Aleingment issuse are also related to the "angular" accuracy required to connect two optoelectronic devices.



Numerical Aperture

$$NA = \sqrt{n_1^2 - n_2^2} \cong n_1\sqrt{2\Delta} \quad \text{where} : \Delta = \frac{n_1 - n_2}{n_1}$$

Acceptance Angle

$$\theta_{acc} = \sin^{-1}\left(\sqrt{n_1^2 - n_2^2}\right) \cong \sin^{-1}\left(n_1\sqrt{2\Delta}\right)$$