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Topic - optical fibres

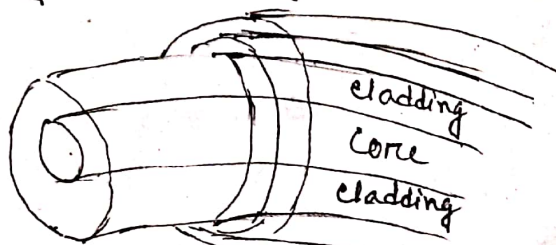
What is fibre optics?

Fibre optics := Fibre optics may be defined as a technology related to transportation of optical energy in guiding media, especially the transparent dielectric fibres of glass, plastic etc.

Structure of optical fibre := Structurally, an optical fibre consists of an inner cylinder usually made of glass and is known as the core. It is the core that carries the light. The dia. of core varies from about  $5\ \mu\text{m}$  to  $100\ \mu\text{m}$ .

The core is surrounded by another coaxial cylindrical shell of refractive index lower than that of the core. This is called the cladding whose diameter is usually about  $125\ \mu\text{m}$ . The function of cladding is to retain the light within the core through total internal reflections.

To provide greater strength and protection, a layer of soft plastic coating of dia about  $250\ \mu\text{m}$  surrounds the cladding. This coating is the primary coating. A second layer of coating, called secondary coating, is often used outside the primary.



## Classification of optical fibres:

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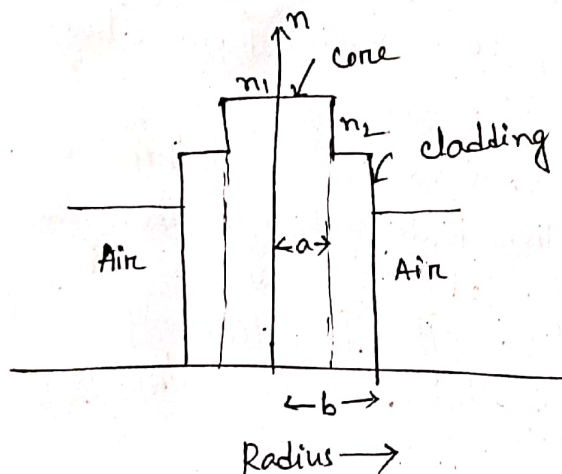
There are mainly two types of optical fibres, based on refractive index profile of the core, namely

- (i) Step-index fibre
- (ii) Graded index fibre.

### (i) Step-index fibre:

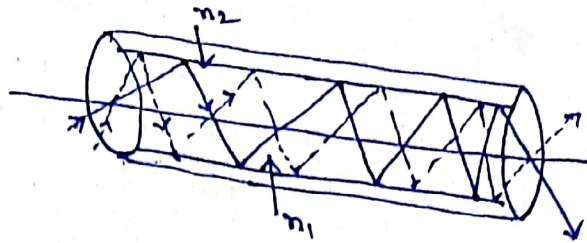
In step-index fibre, the refractive index  $n_1$  of the core is uniform throughout the core. Similarly, the refractive index  $n_2$  of the cladding is also uniform. Necessarily,  $n_1 > n_2$ .

Let  $a$  and  $b$  be the radius of the core and cladding respectively so that  $b > a$ .

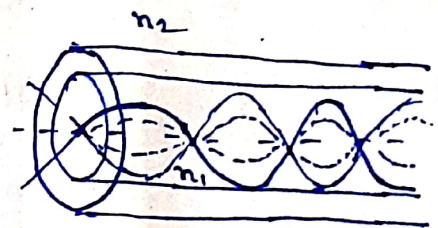
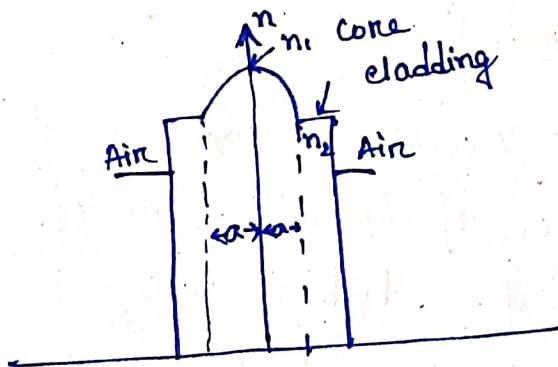


Depending on the launch angle of the incident light into the fibre, there may be a large number of different zig-zag paths of the rays or modes by which energy travels down the core. We have restricted to two rays only, entering at different angles of incidence with the fibre axis and emerging out of the fibre at

different times. This is then called a step-index multi-mode fibre.



(ii) Graded-index fibre := In a graded-index optical fibre, unlike the step index one, the core has a non uniform refractive index that gradually decreases from the centre towards the core-cladding interface. The cladding ~~however has~~ however has a uniform index. The refractive index profile of a graded-index fibre is shown in fig. given below.



Here in multimode graded-index fibre, the ray paths are not zig-zag; they are refracted gradually. At the central region, the index is higher implying that the light velocity is smaller but near the cladding the situation is reverse, the index is smaller and the light velocity is greater.

The reason for using glass for optical fibres are—

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- (i) It has a range of accessible temperatures where its viscosity is variable; it does not solidify at a fixed freezing point but gradually becomes harder and in the transition region can be easily drawn into a thin fibre.
- (ii) Pure silica is characterised by extremely low 'loss' e.g, in commercial silica fibres 96% of power gets transmitted through 1 km of optical fibre.
- (iii) Its intrinsic strength is as high as  $2 \times 10^{16}$  lb/inch<sup>2</sup>.

What is acceptance angle?

Acceptance angle :- Acceptance angle is defined as the maximum value of launch angle of incident light into the fibre for which the ray is totally internally reflected at core cladding interface and gets transmitted without loss.

The acceptance angle is a measure of the light gathering power of the fibre.