

Fiber optics:

1: Explain the different types of losses resulting in propagation of light through optics fibre.

Ans: The loss is found to be a function of fibre material, wavelength of light and dimension of the fibre.

Bending loss:

- Occurs when the fibre is bent too sharply causing some of the light to escape from the core.
- Macrobending: Large bends that causes light to leak
- Microbending: Tight bends, light (less loss)

Absorption loss:

- When impurities in the fibre absorb part of the light energy, converting it into heat. defects from the impurities.

Scattering loss:

- As light travels, it can scatter in different direction due to irregularities in the material.

2. Define acceptance angle and numerical aperture. Derive an expression for numerical aperture and acceptance angle in optical fibre.

Ans: Acceptance Angle:

The acceptance angle is the maximum angle at which light can enter the fibre and still be propagated through the core by TIR.

Angle between the incoming light ray and fibre axis

Numerical aperture:

- Key parameter that represents the light-gathering ability of the fibre. Relates the refractive indices of core (n_1) and cladding (n_2) and determines the range of angles over which the fibre can accept light
- The sine of maximum acceptance angle is called NA

$$NA = \sin(\theta_{\max})$$

- For most fibres $n_1 \approx n_2$

$$NA = \sqrt{n_1^2 - n_2^2}$$

Derivation :

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

For TIR to occur.

$$\sin(\theta_c) = \frac{n_2}{n_1}, \quad \theta_c \text{ is the critical angle}$$

$$NA = \sin(\theta_{max}) = \sqrt{n_1^2 - n_2^2}$$