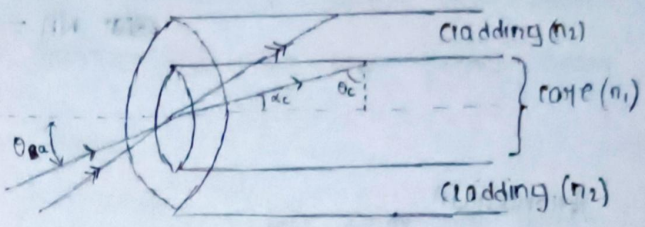
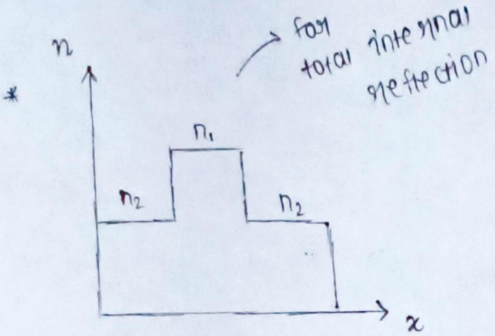
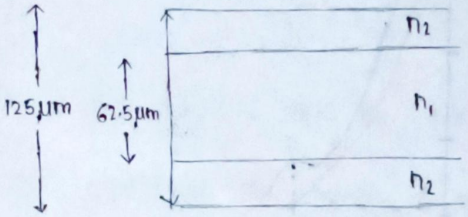
# CONDITION FOR LIGHT PROPAGATION IN OPTICAL FIBRE :




* 


(Step index fibre)

* Applying Snell's law in the core-cladding boundary we get :

$$n_1 \sin\theta_c = n_2 \sin 90^\circ$$

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

$$\Rightarrow \theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

* $\alpha_c$ is the "critical propagation angle"

$$\theta_c = 90^\circ - \alpha_c$$

$$\sin\theta_c = \cos\alpha_c$$

$$\sin\alpha_c = \sqrt{1-\cos^2\alpha_c} = \sqrt{1-\left(\frac{n_2}{n_1}\right)^2} = \sqrt{\frac{n_1^2-n_2^2}{n_1^2}}$$

* Applying Snell's law at the gap fibre interference

$n_a \sin\theta_a = n_1 \sin\alpha_c$ , $\theta_a \rightarrow$ acceptence angle.

$$\Rightarrow \sin\theta_a = \frac{n_1}{n_a}\left(\frac{\sqrt{n_1^2 - n_2^2}}{n_1}\right) = \frac{\sqrt{n_1^2 - n_2^2}}{n_a}$$

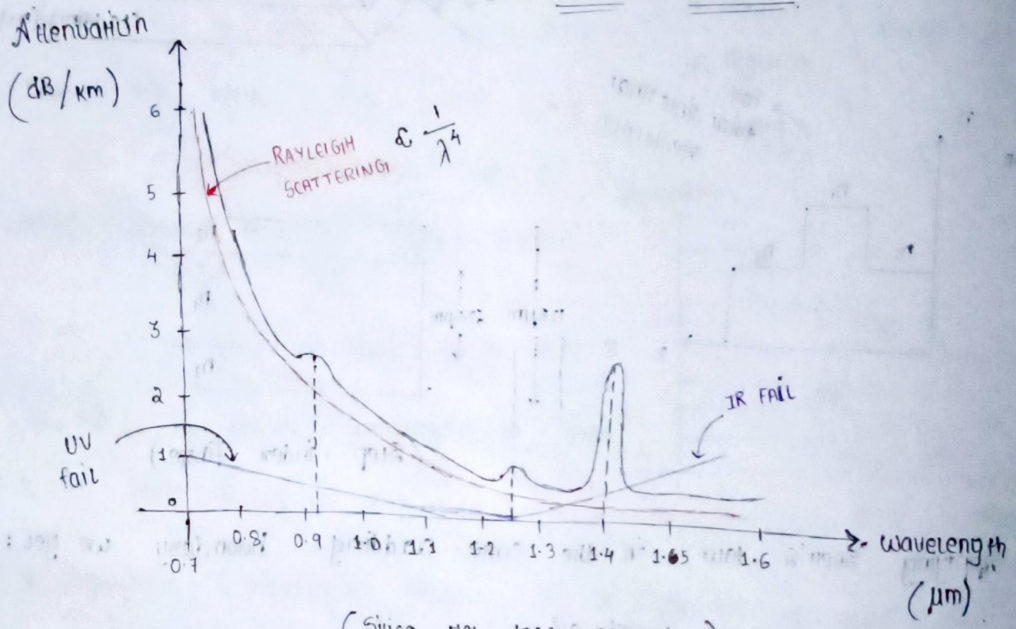
if outside medium is air : $n_a \simeq 1$

then $\sin\theta_a = \sqrt{n_1^2 - n_2^2}$

Numerical aperture → $\boxed{NA = \sqrt{n_1^2 - n_2^2}}$

$NA = n_1\sqrt{2\Delta}$ , $\Delta = \frac{n_1 - n_2}{n}$

## Losses in fiber optics



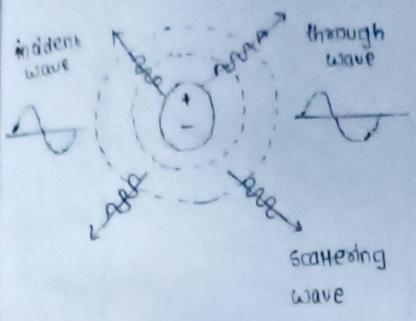

(Silica gel loss spectrum)

→ Three types of loses :

* Absorption loss : It is the process of conversion of EM waves energy into other forms of energy.

Intrinsic silica glass absorption occurs in both uv & IR while uv loses increase at lowest wavelength. IR losses increases at highest wavelength

* Rayleigh scattering loss : It is a wavelength dependent process, that depends on material inhomogeneities smaller than wavelength. It is inversely proportional to $\lambda^4$.




This strong dependence of loss due to Rayleigh scattering on wavelength, restricts the operation of silica optic fibre at lower wavelengths. The loss peaks occur at points of wavelength :

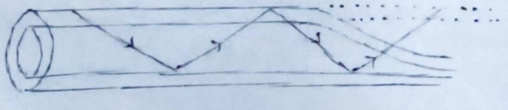
Peaks.
① - 0.93 pm
② - 1.25 pm
③ - 1.40 pm

} lost silica gel from left graph.

* Bending loss :

Bending the fibre also causes attenuation. This is not strongly dependent on wavelength. It is classified as micro & macro bending.

- Microbends are small microscopic bends of fibre axis, that occurs mainly, when a fibre is scabled. ~~and~~



micro

- Macrobends are bends that have large radius of curvature ~~bends~~ relative to the fibre diameter.