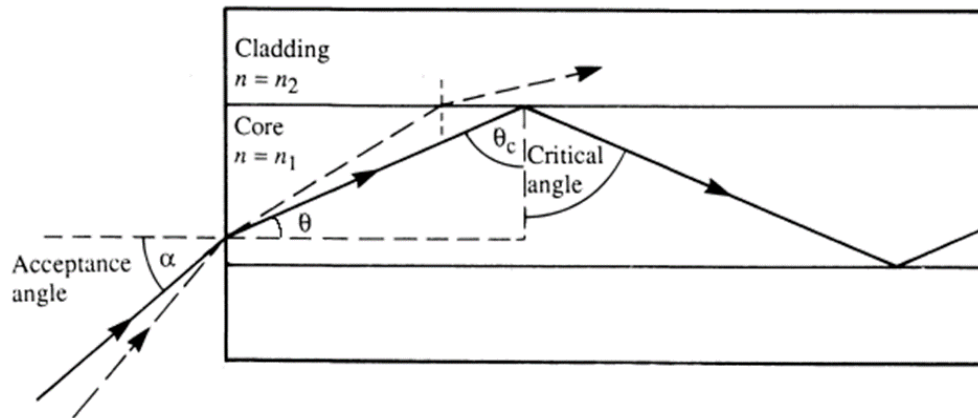


Answer on Question #77792, Physics / Optics

A step index fibre 6.35×10^{-5} m in diameter has a core of refractive index 1.52 and a cladding of refractive index 1.47. Determine the numerical aperture for the fibre and the acceptance angle.

Solution:



The Numerical Aperture (NA) is a measure of how much light can be collected by an optical system such as an optical fibre or a microscope lens.

The NA of any glass combination may be calculated as follows:

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

where n_1 = the index of refraction of the core glass, and n_2 = the index of refraction of the cladding glass.

Thus,

$$NA = \sqrt{1.52^2 - 1.47^2} = 0.387$$

The NA is related to the acceptance angle α , which indicates the size of a cone of light that can be accepted by the fibre.

$$NA = n_0 \sin \alpha$$

where n_0 is refractive index of medium outside the fiber. For air $n_0 = 1.0003$.

Thus,

$$\alpha = \sin^{-1} \left(\frac{NA}{n_0} \right) = \sin^{-1} \left(\frac{0.387}{1.0003} \right) = 22.74^\circ$$

Answer: $NA = 0.387$; $\alpha = 22.7^\circ$

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