

6) An optic fiber in air has a numerical aperture of 0.4. Calculate the acceptance angle.

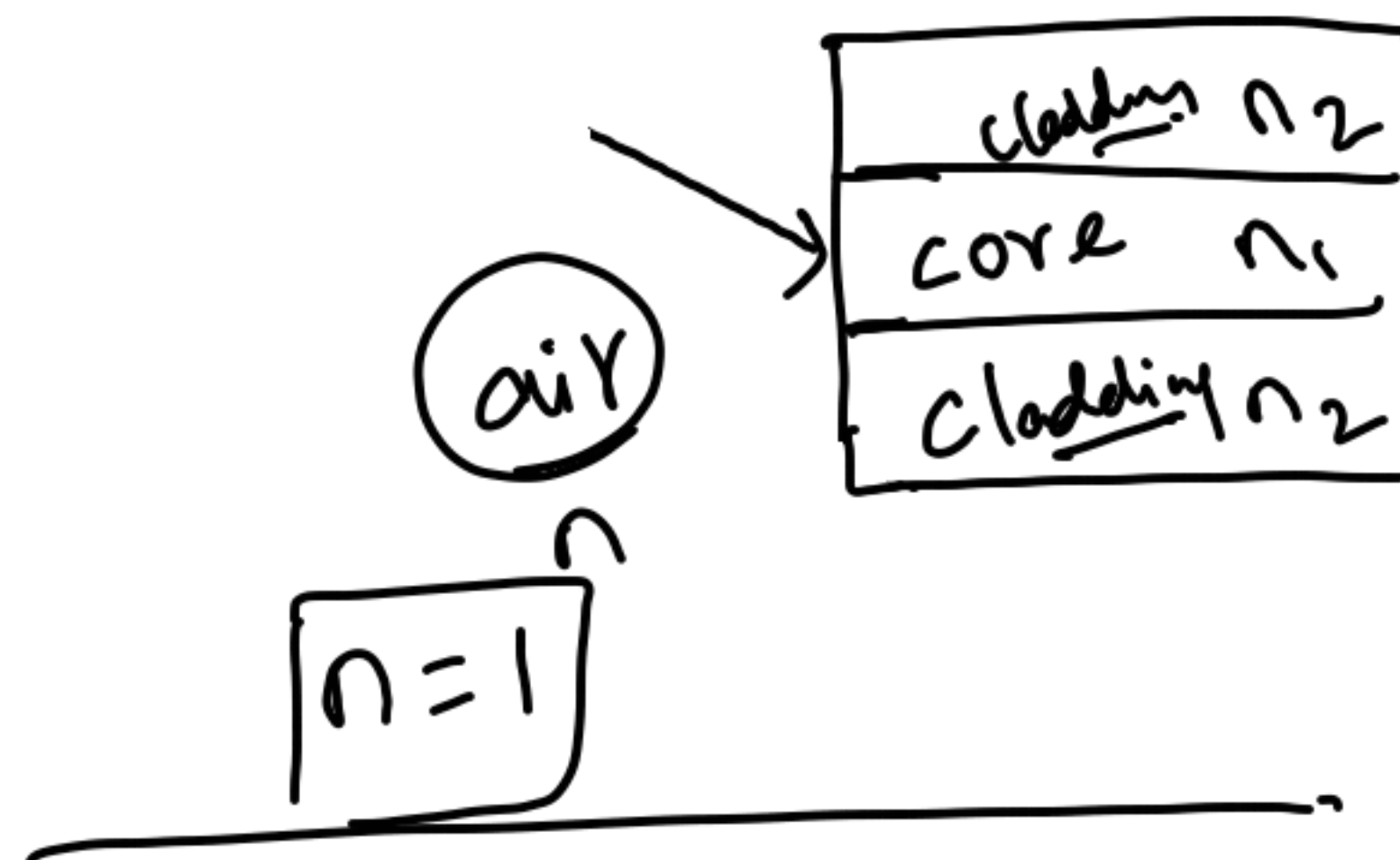
Soln:

$$NA = 0.4$$

$$NA = n \sin \theta_a$$

$$NA = 1 \cdot \sin \theta_a$$

$$NA = \sin \theta_a$$



$$\theta_a = \sin^{-1}(NA)$$

$$\theta_a = \sin^{-1}(0.4)$$

$$\theta_a = 23.57^\circ$$

7) An optic fiber has a NA of 0.48 and the refractive index of the cladding is 1.45. Calculate the refractive index of the core.

Soln:

$$NA = 0.48$$

$$n_2 = 1.45$$

$$n_1 = ?$$

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

Squaring both the side.

$$NA^2 = n_1^2 - n_2^2$$

$$n_1^2 = NA^2 + n_2^2$$

Taking Square root on both the sides.

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

$$n_1 = \sqrt{(0.48)^2 + (1.45)^2}$$

$$n_1 = 1.53$$

8) An OFC System uses an optic fiber with a core refractive index of 1.5 and a cladding refractive index of 1.4. Calculate the acceptance angle of the fiber. assuming the light enters the fiber from air.

Soln ∴

$$n_1 = 1.5$$

$$n_2 = 1.4$$

$$\theta_a = ?$$

$$n = 1$$

$$NA = n \sin \theta_a$$

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

$$NA = 1 \cdot \sin \theta_a$$

$$\theta_a = \sin^{-1}(NA)$$

$$NA = \sqrt{(1.5)^2 - (1.4)^2}$$

$$NA = 0.54$$

$$\theta_a = \sin^{-1}(NA)$$

$$\theta_a = \sin^{-1}(0.54)$$

$$\theta_a = 32.58^\circ$$

9) A rectangular waveguide has a width of 4 cm and height of 2 cm transmit TE_{11} mode. Calculate the cutoff frequency and cutoff wavelength of the waveguide.

Soln:-

$$a = 4 \text{ cm} = 0.04 \text{ m}$$

$$b = 2 \text{ cm} = 0.02 \text{ m}$$

$$TE_{11} = TE_{mn}$$

$$m = 1 \text{ \& } n = 1$$

$$f_c = \frac{c}{2} \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}$$

$$f_c = \frac{3 \times 10^8}{2} \sqrt{\left(\frac{1}{0.04}\right)^2 + \left(\frac{1}{0.02}\right)^2}$$

$$f_c = 8.39 \times 10^9 \text{ Hz} \checkmark$$

$$f_c = 8.39 \text{ GHz}$$

$$10^3 = \text{k}$$

$$10^6 = \text{M}$$

$$10^9 = \text{G}$$

$$\lambda_c = \frac{c}{f_c}$$

$$\lambda_c = \frac{3 \times 10^8}{8.39 \times 10^9}$$

$$\lambda_c = 0.036 \text{ m}$$