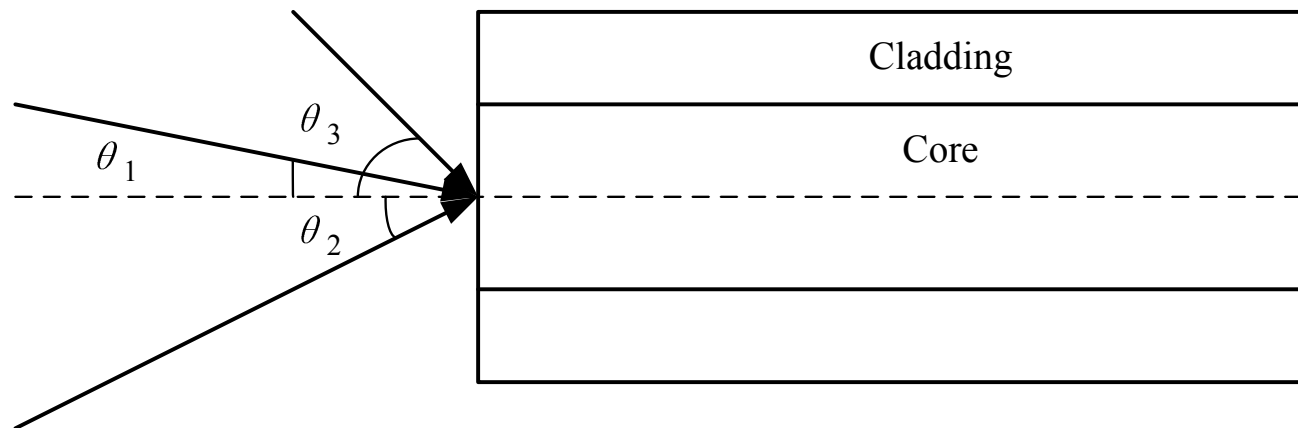


Problems

The data are transmitted using a fiber optical communication system at the bit rate of 50 Kb/s. The fiber is 3 km long. As shown in the figure below, the data modulated light enters the fiber only through three angles, $\theta_1 = 25^\circ$, $\theta_2 = 30^\circ$, $\theta_3 = 45^\circ$. The refractive indexes of air, core and cladding are $n_0 = 1$, $n_1 = 1.5$ and $n_2 = 1.4$, respectively. Is the receiver able to correctly demodulate the signal?



Solution

- Critical angle ϕ_c

$$\sin \phi_c = \frac{n_2}{n_1} = \frac{1.4}{1.5}$$

$$\phi_c = 69^\circ$$

- The refractive angle for the light with the angle, $\theta_1 = 25^\circ$,

$$n_0 \sin 25^\circ = n_1 \sin \theta_r$$

$$\theta_r = 16^\circ$$

The refractive angle for the light with the angles, $\theta_2 = 30^\circ$ and $\theta_3 = 45^\circ$ are 19° and 28° .

- $28^\circ + \phi_c > 90^\circ$, the light with the angle $\theta_3 = 45^\circ$ will not stay in the fiber.
- The difference of travel duration of the light with the angles $\theta_1 = 25^\circ$ and

$\theta_2 = 30^\circ$ is

$$\begin{aligned}\Delta T &= \frac{n_1}{c} \left[\frac{L}{\cos 16^\circ} - \frac{L}{\cos 19^\circ} \right] \\ &= 2.6 \times 10^{-7} \text{ s}\end{aligned}$$

- The symbol duration

$$\frac{1}{50 \times 10^3} = 2 \times 10^{-5} > 2.6 \times 10^{-7} \text{ s}$$

- The receiver is able to correctly demodulate the signal.