

Integrated Photonic Device

Homework 1

2007, Fall

1. Consider a planar waveguide. What is the cut-off condition for TM mode?
2. For a silicon planar waveguide with 0.25-um thickness ($n=3.4$, air-cladding on the two sides), what are the β s of TM mode and TE mode ($m=0$) for wavelength from 1520 nm to 1560 nm?

Hint:

$$\left\{ \begin{array}{l} \frac{\partial^2 \mathbf{E}_y}{\partial x^2} + (n^2 k_0^2 - \beta^2) \mathbf{E}_y = 0 \\ \mathbf{H}_x = -\frac{\beta}{\omega \mu_0} \mathbf{E}_y \\ \mathbf{H}_z = -\frac{j}{\omega \mu_0} \frac{d\mathbf{E}_y}{dx} \end{array} \right. \quad \begin{array}{c} \mu_0 \\ H \end{array} \quad \begin{array}{c} \text{Reciprocal} \\ \longleftrightarrow \end{array} \quad \begin{array}{c} \varepsilon_0 n^2 \\ E \end{array} \quad \left\{ \begin{array}{l} \frac{d^2 \mathbf{H}_y}{dx^2} + (n^2 k_0^2 - \beta^2) \mathbf{H}_y = 0 \\ \mathbf{E}_x = \frac{\beta}{\omega \varepsilon_0 n^2} \mathbf{H}_y \\ \mathbf{E}_z = \frac{j}{\omega \varepsilon_0 n^2} \frac{d\mathbf{H}_y}{dx} \end{array} \right.$$