The Effective Index

A plane wave propagates with a phase term $e^{jnk_0 z}$ where $k_0 = 2\pi/\lambda_0$ is the free-space wavevector.

We can define an effective index for a guided wave that has a phase factor $e^{j\beta z}$ with:

$$\boxed{\beta \equiv \frac{n_{eff} 2\pi}{\lambda_0}}$$

Then

$$\frac{n_2 2\pi}{\lambda_0} < \beta < \frac{n_1 2\pi}{\lambda_0}$$

$$\Rightarrow \boxed{n_2 < n_{eff} < n_1}$$

The effective index is an “average” index seen by the guided wave.