

## Silicon Photonics Homework #2

HW 2-1. (a) Please find the value of  $\theta_1$  **numerically** or **graphically** by using the plot similar to Fig. 2.6 for the TE<sub>0</sub> ( $m = 0$ ) mode asymmetrical planar waveguide with the following parameters:  $n_1 = 1.5$ ,  $n_2 = 1.49$ ,  $n_3 = 1.40$ ,  $\lambda_0 = 1.3 \mu\text{m}$ , and  $h = 0.5 \mu\text{m}$  (Silica waveguide). (b) Is it possible for the calculated mode to be guided in this waveguide? Why?

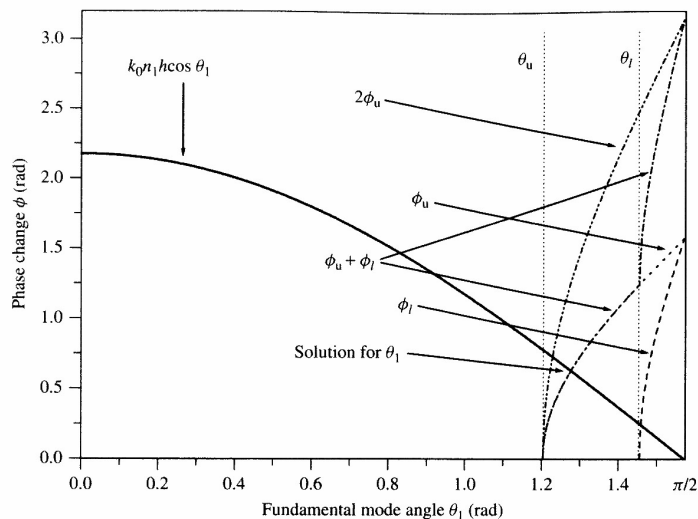


Figure 2.6 Solution of the eigenvalue equation for  $m = 0$

HW 2-2. Repeat HW2-1 for  $n_1 = 1.5$ ,  $n_2 = 1.49$ ,  $n_3 = 1.40$ ,  $\lambda_0 = 1.3 \mu\text{m}$ ,  $h = 5 \mu\text{m}$  (Silica waveguide). (a) Find the value of  $\theta_1$  for TE<sub>0</sub> mode ( $m = 0$ ) **numerically** or **graphically**. (b) Is it possible for the calculated mode to be guided in this waveguide? Why? (c) If the answer is YES, what is the effective index  $N$  of the calculated mode?

HW 2-3. Consider an asymmetrical planar waveguide with  $n_1 = 3.5$ ,  $n_2 = 1.5$ ,  $n_3 = 1.0$  and  $\lambda_0 = 1.3 \mu\text{m}$  (SOI waveguide). (a) What is the range of the core thickness  $h$  for only TE<sub>0</sub> (monomode) operation? (b) If the core thickness  $h = 0.2 \mu\text{m}$ , how many TE modes can be supported in this waveguide? (c) Please plot the **Field distribution ( $E$ )** and the **Intensity distribution ( $|E|^2$ )** schematically for all the allowed TE <sub>$m$</sub>  modes ( $m=0,1,\dots$ ) when the core thickness  $h = 0.2 \mu\text{m}$ .