Major Task(ECE332s)

MINA AYAD YOUNAN

QUESTIONS

(a) Design a symmetric slab waveguide with core and cladding refractive indexes $n_1 = 1.75$ and $n_2 = 1.65$ that supports ten TE guided modes at a wavelength of 1.55 μm.

To support 10 number of mode:

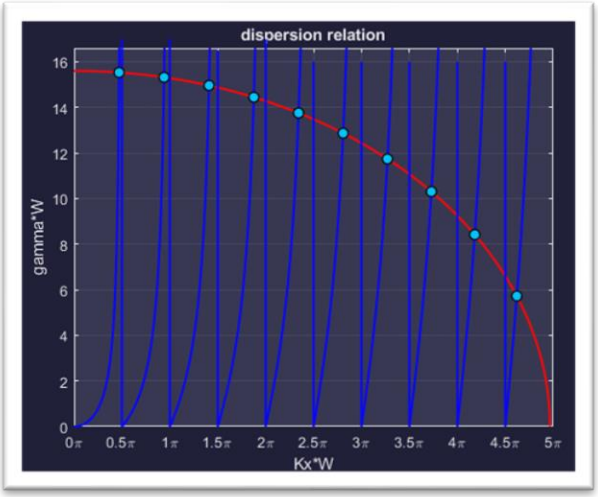
$$V = \frac{2*\pi}{\lambda} * W * NA$$

$$\frac{9*\pi}{2} < V < \frac{10*\pi}{2} \rightarrow 5.98um < W < 6.64um$$

Select: W = 6.60um

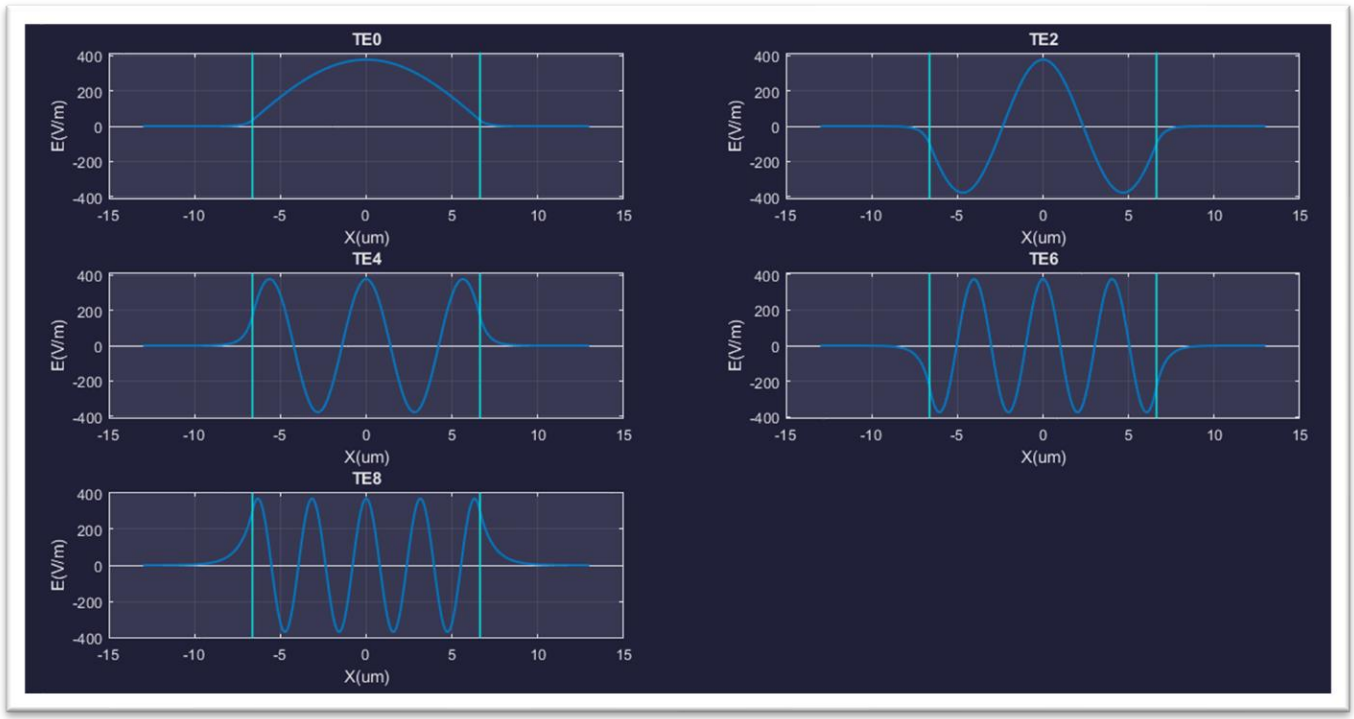
(b) Write MATLAB codes to calculate the effective indexes and the normalized *Ey* field of the TE modes of the designed waveguide.

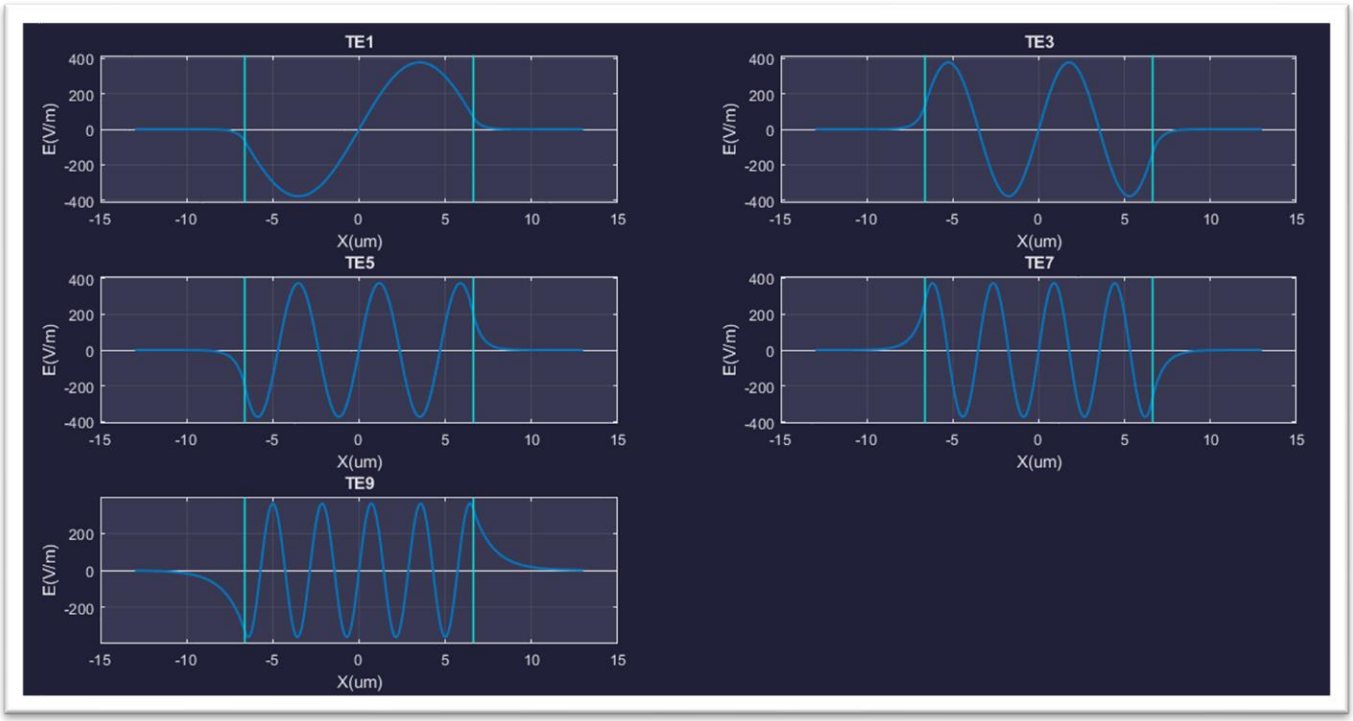
Multi-Mode at Width 13.20 um



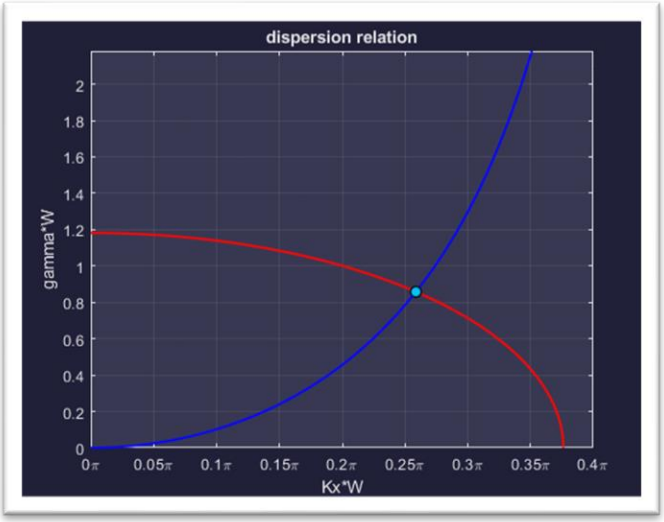

```
core Width is(2W): 13.2000u
effective index of mode 0 = 1.7491
effective index of mode 1 = 1.7465
effective index of mode 2 = 1.7422
effective index of mode 3 = 1.7361
effective index of mode 4 = 1.7282
effective index of mode 5 = 1.7186
effective index of mode 6 = 1.7073
effective index of mode 7 = 1.6943
effective index of mode 8 = 1.6797
effective index of mode 9 = 1.6638
```

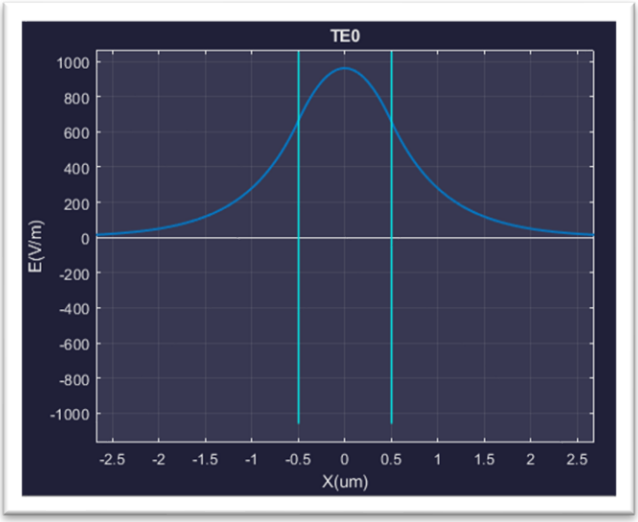
```
normalized Ey: 377.288901
normalized Ey: 377.132617
normalized Ey: 376.856066
normalized Ey: 376.434601
normalized Ey: 375.826230
normalized Ey: 374.942188
normalized Ey: 373.657094
normalized Ey: 371.618157
normalized Ey: 367.997146
normalized Ey: 359.132415
```


TE0
TE2
TE4
TE6
TE8
E(V/m)
X(um)


TE1
TE3
TE5
TE7
TE9
E(V/m)
X(um)

Single Mode at Width 1um






```
core Width is(2W): 1.0000u
effective index of mode 0 = 1.7035
```

C(1) Calculate the overlap integral between this mode and the modes of the MM waveguide

```
OverLap Integeral of TE0 : 0.603146
OverLap Integeral of TE1 : -0.000000
OverLap Integeral of TE2 : 0.523576
OverLap Integeral of TE3 : -0.000000
OverLap Integeral of TE4 : 0.410420
OverLap Integeral of TE5 : -0.000000
OverLap Integeral of TE6 : 0.304147
OverLap Integeral of TE7 : -0.000001
OverLap Integeral of TE8 : 0.219153
OverLap Integeral of TE9 : -0.000001
```

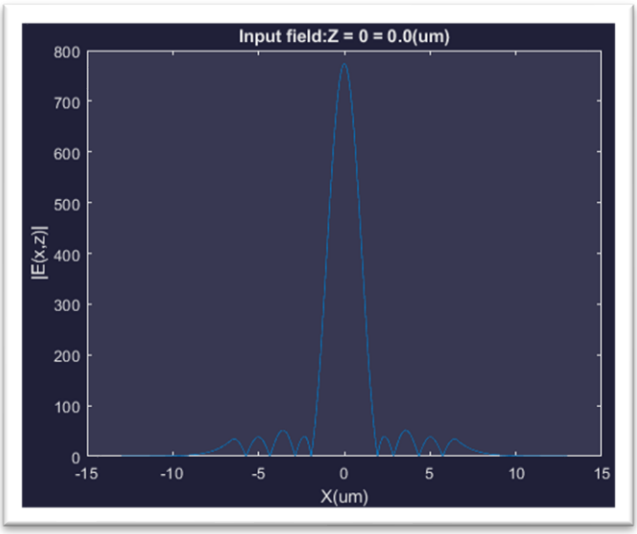
C(2) Use this overlap integral to find the field at different propagation distance.

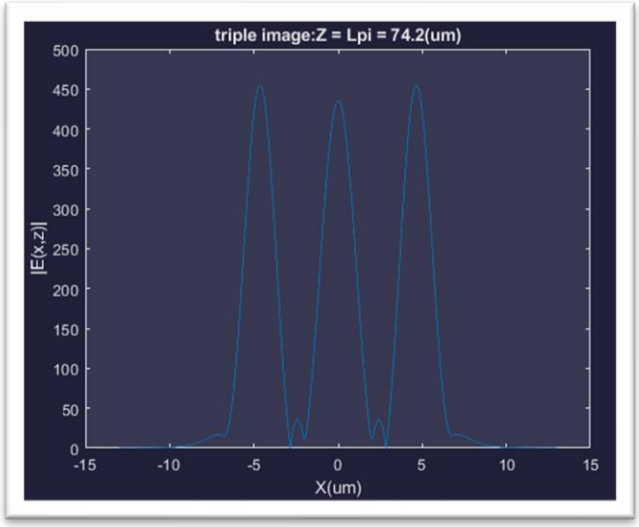
& C(4) Identify the self-imaging distance of the launched field.

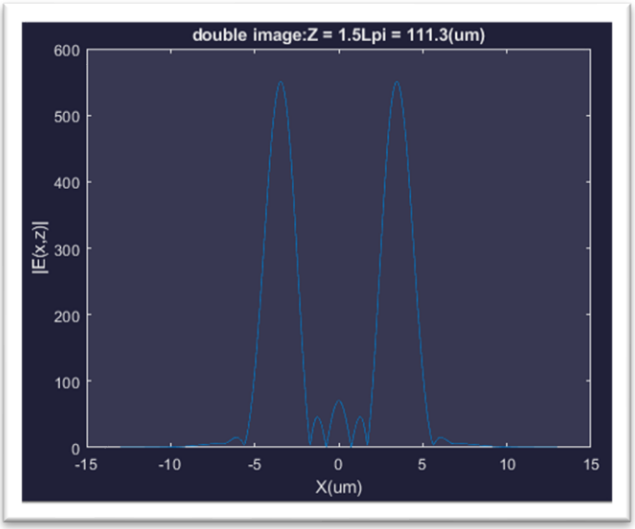
self-image distance = $\frac{2*pi}{\beta_0-\beta_2} = \frac{2*\pi*\lambda}{(N_{eff-0}-N_{eff-2})*2*\pi}$ **= 224.62um**

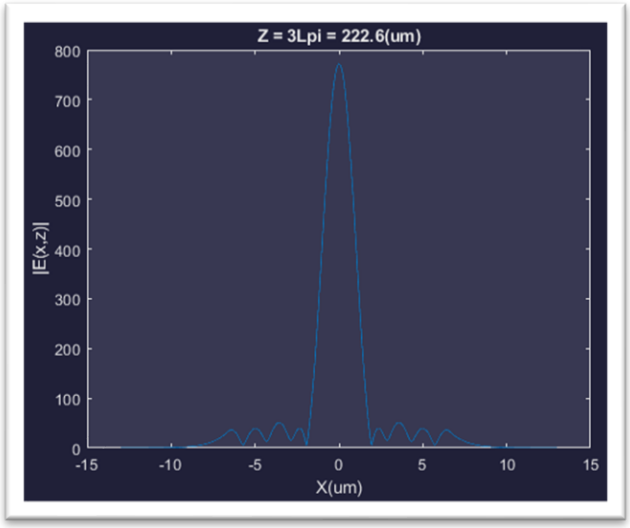
Comment on L :

The reason we calculate L by above equation using β_2 instead of β_1 is due to β_2 will note propagate so we can get shorter distance at which we can get self image

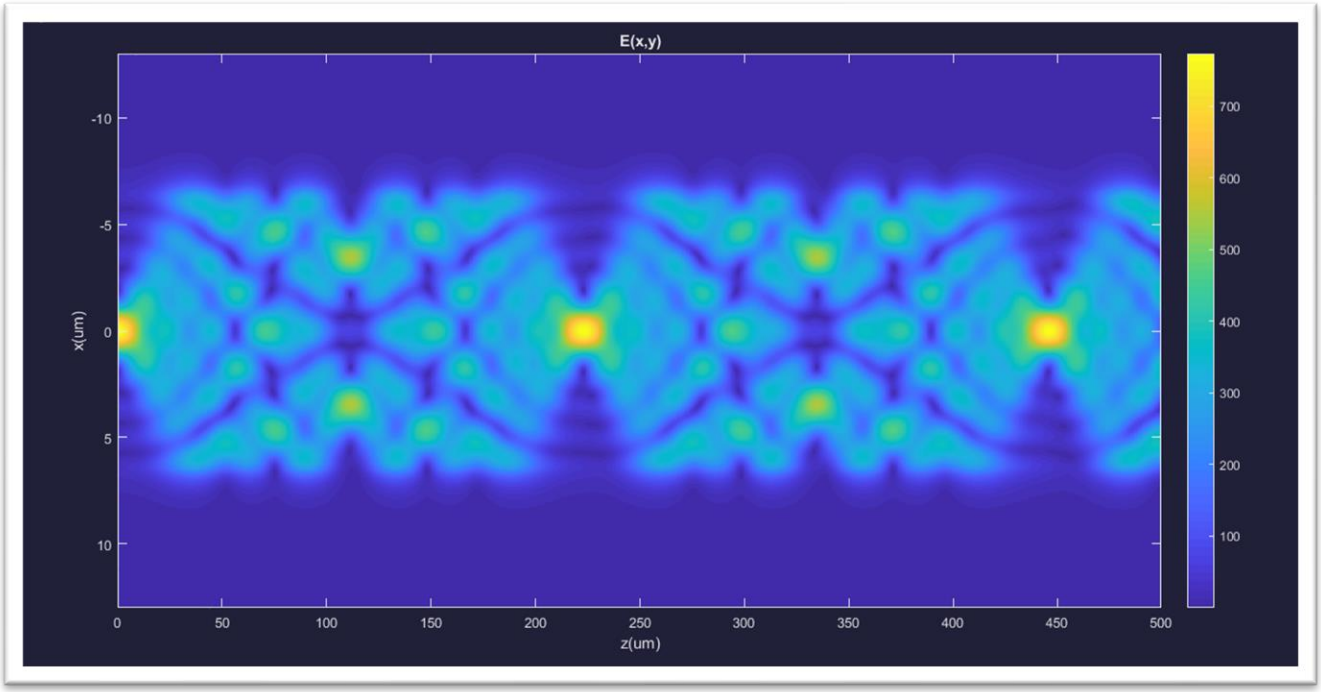








C(3) Plot the field intensity as a function of the transverse direction x and the propagation distance z inside the MM waveguide.



(d) Suppose that both MM and SM waveguides are implemented using a rib waveguide geometry in which the core, substrate, and cover refractive indices are 2.0, 1.5, and 1, respectively. Find the thickness of the core in the slab and rib regions. What is the rib width of each waveguide?

```
The thickness in Rib 0.440070 (um)
The thickness in slab 0.306924 (um)
The Width of Rib 13.293833 (um)
>>
```

To find W of Rip we have to solve for TM mode and we will get the same width as we get in multimode structure

$$total\ width\ (2W) = 13.2um$$