

## Assignment 4

- For the rectangular waveguide, find the following.
  - Fields of  $TM_{mn}$  modes.
  - Cutoff frequencies of  $TM$  modes.  
What is lowest cutoff frequency?
- For the  $TM_{11}$  mode, find:
  - Poynting vector  $\langle \vec{S} \rangle$
  - Power propagating in waveguide
  - Average energy density
  - Average energy per unit length
  - Speed of energy propagation  
How is this related to the phase velocity?