

ENEE 381 Problem Set #6

A guide for studying for the final. Optional for handing in.

One or two of these questions will be on the final examination.

- (1) A parallel plate waveguide with plate spacing of 10mm allows TM and TE waves to propagate provided they are above their cutoff frequency. Calculate the cutoff frequency of the TM_1 , TM_2 , TM_3 , TE_1 , TE_2 and TE_3 modes.
- (2) A waveguide is formed from two perfect conductors. The conductors are spaced by 50mm with a dielectric of $\epsilon_r=2.25$. For an operating frequency of 10GHz calculate β , v_p , v_g , Z_z , and λ_g for the following modes:
 - (a) TEM mode
 - (b) TM_1 mode
 - (c) TM_2 mode.
- (3) For a rectangular waveguide with dimensions 50mm \times 20mm calculate the cutoff frequencies for the TE_{10} , TE_{20} , $TE_{2,2}$, TM_{11} and TM_{23} modes. How do these cutoff frequencies change if the waveguide is filled with a lossless dielectric with $\epsilon_r=4$?
- (4) A rectangular waveguide of dimension 50mm \times 20mm filled with air is being operated at 1.1 times its cutoff frequency for the TE_{10} mode. Calculate β , Z_z , v_p , v_g , and λ_g for the mode.
- (5) A rectangular waveguide of dimension 20mm \times 10mm is being operated at 1.2 times the cutoff frequency for the TM_{11} mode. Calculate β , Z_z , v_p , v_g , and λ_g for the mode.
- (6) A rectangular waveguide of dimension 50mm \times 20mm filled with air is being operated at 1.1 times its cutoff frequency for the TE_{10} mode. The TE wave reaches a section of the waveguide that is now completely filled with a lossless dielectric with $\epsilon_r=3$. Calculate the reflection coefficient in magnitude and phase, VSWR, and the fraction of the incident power that passes into the loaded waveguide section.
- (7) A waveguide of dimension 20mm \times 10mm that is filled with air carries a TE_{10} mode at a frequency of 10GHz. The total power being transferred down the guide is 1W. What is the peak electric field amplitude in the waveguide?