Homework 4
Electromagnetic Waves
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QUESTIONS

1. A parallel-plate air waveguide has a plate separation of 6 mm.
   (a) List the cutoff frequencies of the seven lowest-order modes (TE_m and TM_m) that can propagate in this guide.
   (b) Find all the propagating modes (TE_m and TM_m) at 40 GHz.
   (c) Find all the propagating modes at 60 GHz.
   (d) Repeat part (c) if the waveguide is filled with polyethylene (assume it is lossless, with $\varepsilon_r \approx 2.25, \mu_r = 1$).

2. A waveguide, with dimensions $a = 1$ cm and $b = 0.6$ cm, is to be used at 25 GHz. Determine the wave impedance for the dominant mode when
   (a) the guide is empty, and
   (b) the guide is filled with polyethylene (whose $\varepsilon_r \approx 2.25, \mu_r = 1$).

3. An air-filled rectangular waveguide operates at 40 GHz. If the cutoff frequency of the TE_{12} mode is 25 GHz, calculate the wavelength, phase constant, phase velocity, and intrinsic impedance of this mode.

4. A section of an air-filled rectangular waveguide ($a = 2.4$ cm, $b = 1.2$ cm) operates in the TE_{10} mode. The operating frequency is 25% higher than the cutoff frequency. Determine f_c, f and h ($h^2 = k_x^2 + k_y^2$).