



Arab Academy for Science and Technology & Maritime Transport

College of Engineering & Technology

Department : Electronics & Communication

Course : Wave propagation and Antennas (1)

Course No: EC 443

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Sheet (1): Rectangular WaveGuide

- 1- An air filled rectangular waveguide of inside dimensions 7×3.5 cm operates in the dominant mode TE_{10} mode.
 - a- Find the cut-off frequency
 - b- Determine the phase velocity of the wave in the guide at a frequency of 3.5 GHz.
 - c- Determine the guided wavelength at the same frequency.
- 2- a- For an air-filled waveguide whose inside dimensions are 3×1.5 inch, find the cut-off frequency and cut-off wavelength for the TE_{10} mode.
 - b- For the same waveguide, calculate the field in terms of an arbitrary $A_{10}(H_{z_{\max}})$ for $f = 2.45$ GHz operating in the TE_{10} mode.
- 3- The waveguide in problem (2) has a λ_g of 0.2 m. Find the frequency, phase velocity and group velocity.
- 4- For 3×1.5 inch waveguide in problem (2) and (3), find the frequency range over which operation would be restricted to the dominant mode only.
- 5- a) Design an air-filled rectangular waveguide with $b < a < 2b$, such that when operated at 3 GHz in the dominant mode, it is 20% above the its cut-off frequency and 20% below the cut-off frequency of the next higher order mode.
 - b) How would the guide dimensions be affected, if the guide is to be filled with a dielectric with a relative permittivity $\epsilon_r = 4$?
 - c) Discuss the situation when $a > 2b$?
- 6- a) For $\lambda_o = 10$ cm, design a rectangular waveguide with air dielectric so that the dominant mode will propagate with $f_o = 1.3f_c$, but also that the mode with the next higher cut-off frequency will be 30% below its cut-off frequency knowing that $b/a = 0.5$.
 - b) How would the guide dimensions be affected, if the guide is to be filled with a dielectric with a relative permittivity $\epsilon_r = 4$?
- 7- A rectangular waveguide has the dimensions $a = 3.175$ cm and $b = 1.5875$ cm. A source generating frequencies $f_1 = 10$ GHz and $f_2 = 18$ GHz is connected to the input of the guide. Determine the mode in which each frequency component may propagate in the guide?
- 8- For the dominant mode, find the waveguide wavelength and impedance for a waveguide having the dimensions $a = 2.286$ cm and $b = 1.016$ cm for the following frequencies: $f_1 = 10$ GHz and $f_2 = 12$ GHz
- 9- Is it possible to propagate a TEM wave in waveguide and Why?