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 (2): Rectangualr WaveGuide (Cont.)

1- A length of air filled copper X-band waveguide, with a dimensions $a = 2.286cm$ and $b = 1.016cm$. Find the cut-off frequency of the first four propagating modes. What is the attenuation in dB due to conductor loss of a 1 meter length of this guide, when operating at $f = 10GHz$. The waveguide is made of copper with conductivity $\sigma = 5.8 \times 10^8$ S/m.

2- An air-filled waveguide with a cross section 2×1 cm transports energy in TE_{10} mode at rate 0.5hp. The impressed frequency is 30 GHz. What is the peak value of the electric filed occurring in the guide?

3- a) Find the waveguide wavelength and impedance for a guide having the dimensions $a = 2.286cm$ and $b = 1.016cm$ at the dominant mode for the following frequencies: $f_1 = 8.2GHz$ and $f_2 = 12.4GHz$

b) Find the frequency at which TM_{11} mode starts to propagate and calculate the wave impedance for this mode at frequencies below and above 20%.

4- A TE_{10} mode with $f_o = 1.25 f_c$ propagates in the lossless rectangular waveguide with the following dimensions $a = 2.286cm$ and $b = 1.016cm$ the maximum electric filed intensity allowed is $15KV/cm$ (rms). Calculate the power transmitted in guide, the guide impedance and wavelength.

5- For a rectangular waveguide, show that the attenuation due to its imperfect dielectric filling is given by:

$$\alpha_d = \frac{\sigma}{2} \frac{\sqrt{\mu/\varepsilon}}{\sqrt{1-(f_c/f_o)^2}} \text{ Np/m for all Modes}$$

6- A rectangular waveguide of dimensions 2×1 carriers 50 Kw in the dominant mode at $f_o = 1.3 f_c$. The conductivity of this guide is 6.17×10^7 S/m. The transverse magnetic filed is related to the longitudinal component by:

$$H_x = \frac{-j\beta_g}{k_c^2} \frac{\partial H_z}{\partial x}$$

Determine: a) The velocity of energy flow of the guide (v_g)

b) The power dissipation per unit area.

7- Compute the TE_{10} mode attenuation of waveguide in dB/m, for a length of k-Band waveguide operate at $f = 20GHz$. The waveguide is made of brass, is filled with dielectric material having $\varepsilon_r = 2.6$ and $\tan\delta = 0.001$.

8- An attenuator can be made using a section of waveguide operating below cut-off. If $a = 2.286cm$ and the operating frequency is $f = 12GHz$, determine the required length of the below cut-off section of waveguide to achieve an attenuation of 100 dB between the input and output waveguides the effect of reflections at the step discontinuous.