Microwave Engineering

27/06/13

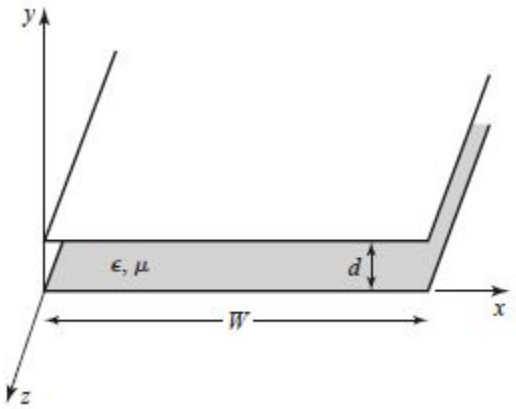
Cognome:	Nome:	Matricola:

Exercise 1

Consider a parallel plate waveguide, where two metal sheets (of width W) sandwich a dielectric region ($\varepsilon = \varepsilon_0\varepsilon_r$ and μ_0) of thickness d.

a) Assuming W>>d and neglecting fringe effects:
determine the expression of the propagation constant and of the electric and magnetic fields of the fundamental mode of the waveguide;
determine the characteristic impedance.

b) Assuming a lossless dielectric and a finite metal conductivity σ, derive the expression for the loss coefficient of the fundamental mode of the waveguide.



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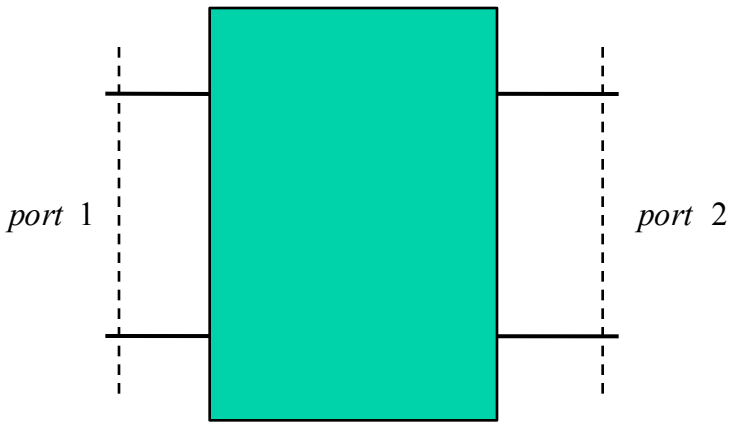
Exercise 2

a) Define the scattering matrix of an N-port network.

b) Consider the lossless and reciprocal 2-port junction schematically described in the figure. We know that:
• with the output terminated in a matched load, the VSWR at input is 3 and port 1 is at a voltage maximum
• with the input terminated in a matched load, port 2 is at a voltage minimum.
Determine the scattering matrix S.



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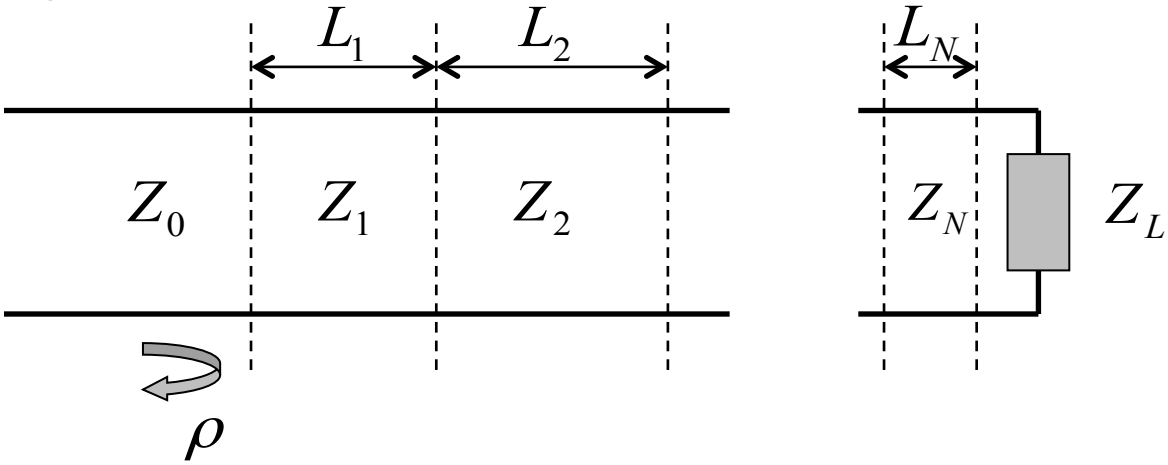
Exercise 3

a) Introduce the theory of small reflections for the analysis of multisection transformers. Define clearly all the assumptions and the limits of this theory. Provide an example describing how this approach can be useful in the design of multisection transformers (i.e. derive the expression for the reflection coefficient ρ of the line schematically described in the figure).



b) Design a four-section binomial transformer to match a 50 Ω load to a 100 Ω line and determine the fractional frequency bandwidth at |ρ|=0.05.