BENHA UNIVERSITY
FACULTY OF ENGINEERING AT SHOUBRA

Post-Graduate
ECE-601
Active Circuits

Lecture #1
Introduction

Instructor:
Dr. Ahmad El-Banna

OCTOBER 2014

Agenda

- Course Objectives
- Course Information
- Basic Concepts

Course Objectives

- ***Studying Scattering matrices.***
- ***Studying multilevel Micro-Strip lines.***
- ***Inactive Components: Filters, Circulators, Power Dividers , .. etc.***
- ***Active Micro-strip Circuits.***
- ***Design of Active Micro-strip Circuits***

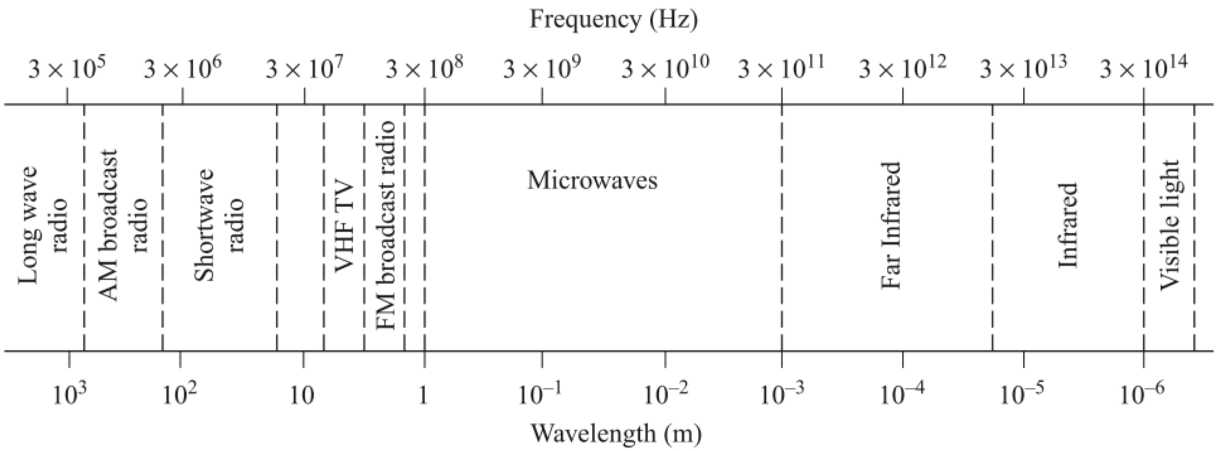
Course Information (Part A)

Instructor:	Dr. Ahmad El-Banna *http://bu.edu.eg/staff/ahmad.elbanna* Office: Room #306 Email: ahmad.elbanna@feng.bu.edu.eg
Lectures:	Tuesday :16:30-18:30 Prerequisite: Microwave Courses
Office Hours:	Sunday(10:30~11:30),Tuesday(14:00~16:30)&Wednesday (14:00~16:30)
T.A.:	NA
Texts/Notes:	• Lectures slides, available by each lecture, and found online at *http://bu.edu.eg/staff/ahmad.elbanna-courses* • **Microwave Engineering**, *D. Pozar, 4th edition, 2012.* • **Foundations for Microwave Engineering** , *Robert E. Collin , 2000*

Review

BASIC CONCEPTS

Microwave Engineering

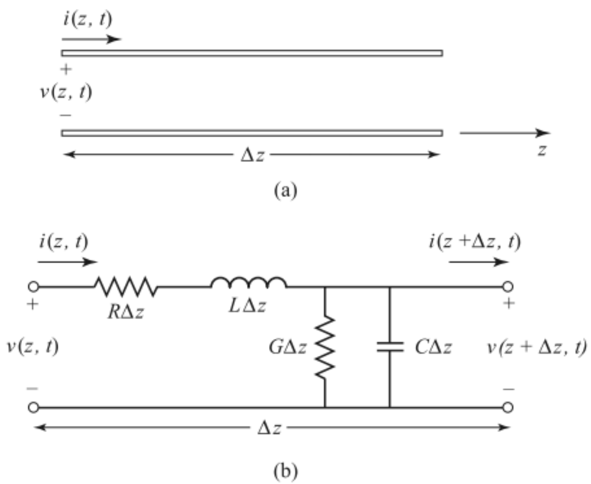


- Maxwell's equations are a set of partial differential equations that, together with the Lorentz force law, form the foundation of classical electrodynamics, classical optics, and electric circuits. These fields in turn underlie modern electrical and communications technologies.
- Maxwell's equations describe how electric and magnetic fields are generated and altered by each other and by charges and currents.
- The wave equation is an important second-order linear partial differential equation for the description of waves – as they occur in physics – such as sound waves, light waves and water waves.

Applications of u wave Engineering

- Just as the high frequencies and short wavelengths of microwave energy make for difficulties in the analysis and design of microwave devices and systems.
- These same aspects provide unique opportunities for the application of microwave systems.
- The following considerations can be useful in practice:
  - Antenna gain is proportional to the electrical size of the antenna.
  - More bandwidth (directly related to data rate) can be realized at higher frequencies.
  - Microwave signals travel by line of sight and are not bent by the ionosphere as are lower frequency signals.
- The majority of today's applications of RF and microwave technology are to wireless networking and communications systems, wireless security systems, radar systems, environmental remote sensing, and medical systems.

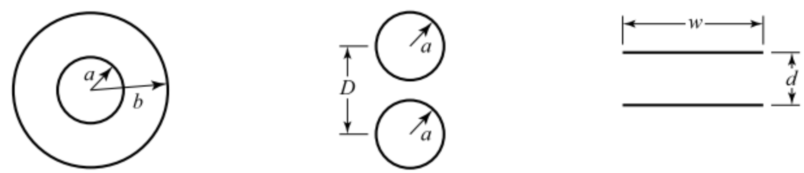
Transmission Lines



Voltage and current definitions and equivalent circuit for an incremental length of transmission line. (a) Voltage and current definitions. (b) Lumped-element equivalent circuit.

R = series resistance per unit length, for both conductors, in Ω/m.
L = series inductance per unit length, for both conductors, in H/m.
G = shunt conductance per unit length, in S/m.
C = shunt capacitance per unit length, in F/m.

Transmission Line Parameters for Some Common Lines

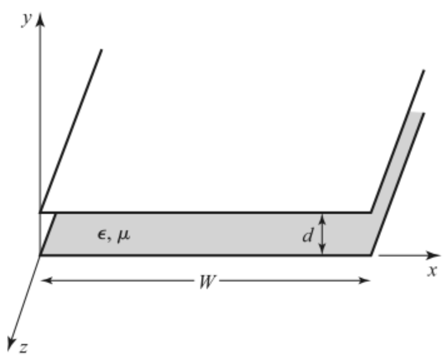


	COAX	TWO-WIRE	PARALLEL PLATE
L	$\frac{\mu}{2\pi}\ln\frac{b}{a}$	$\frac{\mu}{\pi}\cosh^{-1}\left(\frac{D}{2a}\right)$	$\frac{\mu d}{w}$
C	$\frac{2\pi\epsilon'}{\ln b/a}$	$\frac{\pi\epsilon'}{\cosh^{-1}(D/2a)}$	$\frac{\epsilon' w}{d}$
R	$\frac{R_s}{2\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$	$\frac{R_s}{\pi a}$	$\frac{2R_s}{w}$
G	$\frac{2\pi\omega\epsilon''}{\ln b/a}$	$\frac{\pi\omega\epsilon''}{\cosh^{-1}(D/2a)}$	$\frac{\omega\epsilon'' w}{d}$

TRANSMISSION LINES AND WAVEGUIDES

- A transverse mode of a beam of electromagnetic radiation is a particular electromagnetic field pattern of radiation measured in a plane perpendicular (i.e., transverse) to the propagation direction of the beam.
- Transverse modes occur in radio waves and microwaves confined to a waveguide, and also in light waves in an optical fiber and in a laser's optical resonator
- Modes in waveguides can be classified as :
  - *Transverse electromagnetic* (*TEM*) *modes*: neither electric nor magnetic field in the direction of propagation.
  - *Transverse electric* (*TE*) *modes*: no electric field in the direction of propagation. These are sometimes called *H modes* because there is only a magnetic field along the direction of propagation (*H* is the conventional symbol for magnetic field).
  - *Transverse magnetic* (*TM*) *modes*: no magnetic field in the direction of propagation. These are sometimes called *E modes* because there is only an electric field along the direction of propagation.
  - *Hybrid modes*: non-zero electric and magnetic fields in the direction of propagation.

TRANSMISSION LINES AND WAVEGUIDES



Geometry of a parallel plate waveguide.

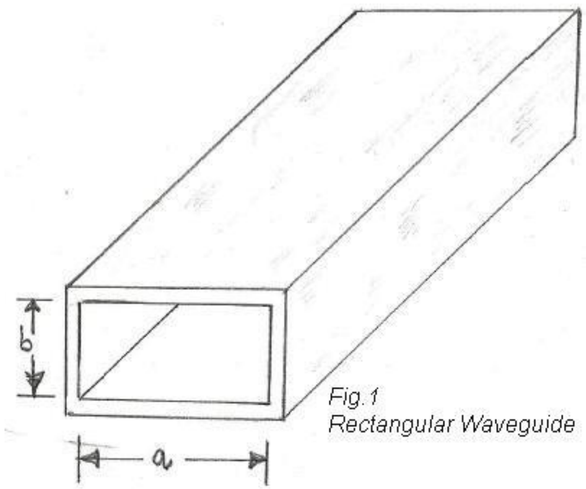
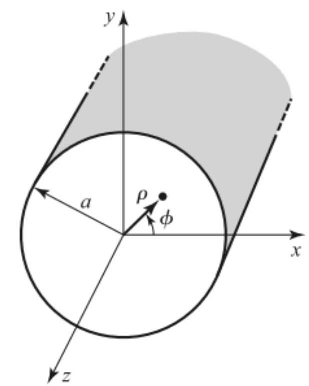
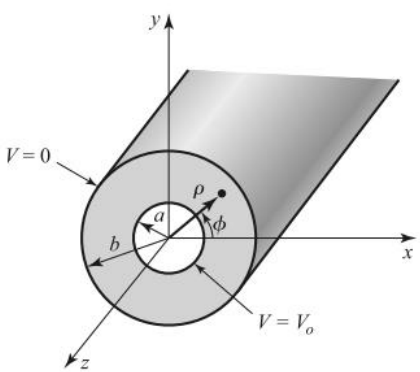


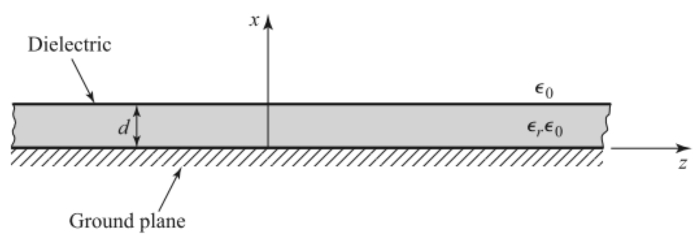
Fig.1
Rectangular Waveguide



Geometry of a circular waveguide.



Coaxial line geometry.



8 Geometry of a grounded dielectric sheet.

TRANSMISSION LINES AND WAVEGUIDES

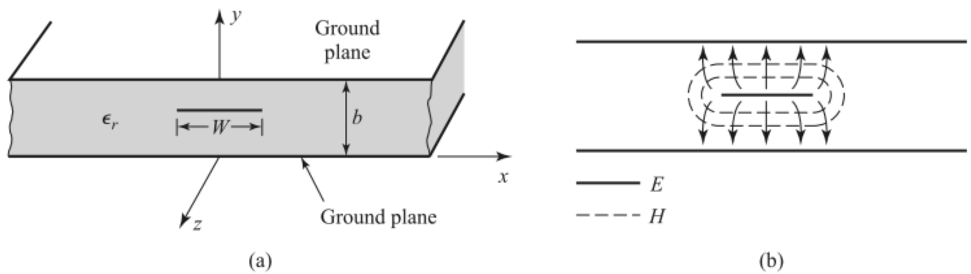
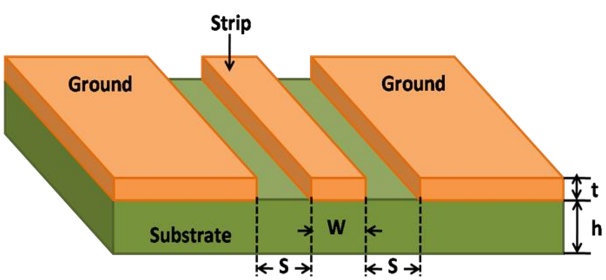


FIGURE 3.22 Stripline transmission line. (a) Geometry. (b) Electric and magnetic field lines.



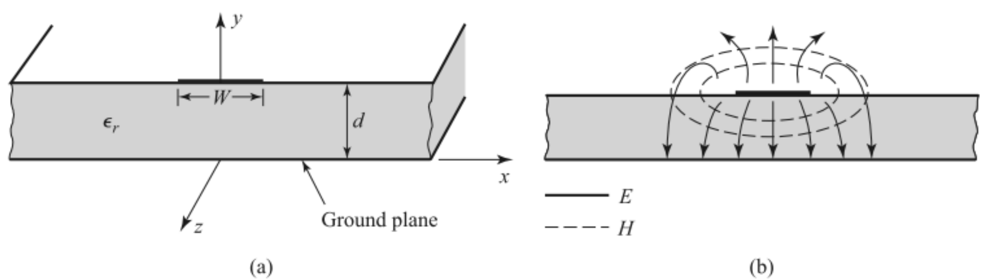


FIGURE 3.25 Microstrip transmission line. (a) Geometry. (b) Electric and magnetic field lines.

- For more details, refer to:
  - Chapters 1-3, Microwave Engineering, David Pozar_4ed.
- The lecture is available online at:
  - *http://bu.edu.eg/staff/ahmad.elbanna-courses*
- For inquires, send to:
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