

# Antenna Engineering

## Lecture 0: Introduction

ELCN405 – Fall 2011

Communications and Computer Engineering  
Program

Faculty of Engineering – Cairo University

# Outline

## 1 Why Study Antenna Engineering?

- Electromagnetic Spectrum
- Recent Advances
- Electromagnetic Wave Propagation
- This Course

## 2 Antennas?

- Definitions of Antennas
- Pictures of Antennas

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- Definitions of Antennas
- Pictures of Antennas

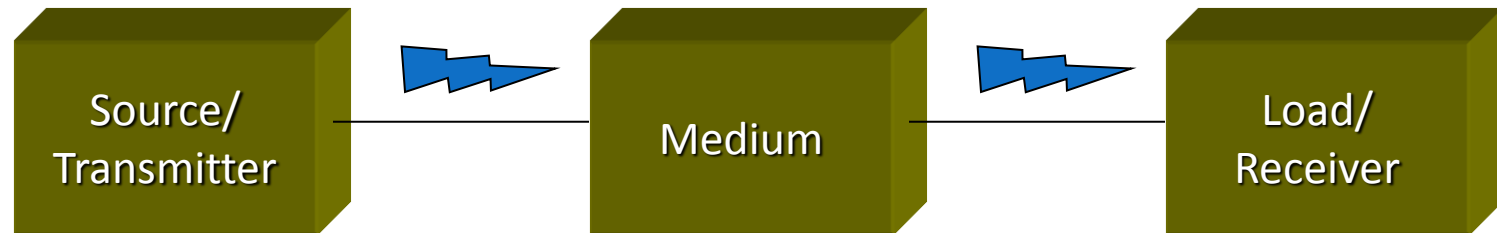
## Electromagnetic Spectrum Applications

Band name	Abbr.	ITU Band	Frequency Wavelength	Example Uses
Low Frequency	LF	5	30–300 kHz 10–1 km	AM long-wave broadcasting.
Medium Frequency	MF	6	300–3000 kHz 1 km – 100 m	AM (medium-wave) broadcasts.
High Frequency	HF	7	3–30 MHz 100 m – 10 m	Shortwave broadcasts, amateur radio, aviation communications.
Very High Frequency	VHF	8	30–300 MHz 10–1 m	FM, television, ground-to-aircraft and aircraft-to-aircraft communications.
Ultra High Frequency	UHF	9	300–3000 MHz 1 m – 100 mm	Television, microwave ovens, mobile phones, wireless LAN, Bluetooth.
Super High Frequency	SHF	10	3–30 GHz 100–10 mm	Microwave devices, wireless LAN, most modern radars, satellite.

The antenna is an important component in any wireless communication system!

# Electromagnetic Wave Propagation

## Typical System



## Electromagnetic Wave Propagation

## Guided vs. Unguided Propagation

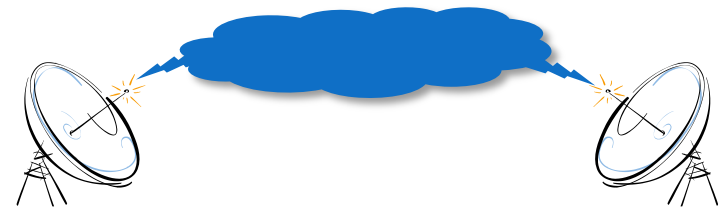
## Guided Propagation

Transmission Lines,  
Waveguides,  
Optical Fibers, ... etc.



## Unguided Propagation

Propagation in Free-Space  
(Ideal)  
Propagation in the  
Atmosphere.



## This Course

## Topics in This Course

- Introduction to Antennas and Radiation Mechanism
- Radiation Integrals
- Basic Antenna Parameters
- Types of Antennas
- Antennas in Receiving Mode
- Antenna Arrays
- Microwave Link Design

## References

- [1] C. A. Balanis, *Antenna Theory: Analysis and Design, 3rd Edition*, 3rd ed. Wiley-Interscience, 2005. (Text book)
- [2] R. E. Collin, *Antennas and Radiowave Propagation*. McGraw-Hill College, 1985.



## This Course

## Course Grade Distribution

- Midterm Exam: 20%
- Projects/Reports/Quizzes: 40%
- Final Exam: 40%

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## Antenna Definitions

# What is an Antenna?

An antenna is a device that launches/picks up electromagnetic power.

*Wikipedia:* An antenna (or aerial) is a transducer designed to transmit or receive electromagnetic waves.

*IEEE:* antenna (aerial). A means for radiating or receiving radio waves.



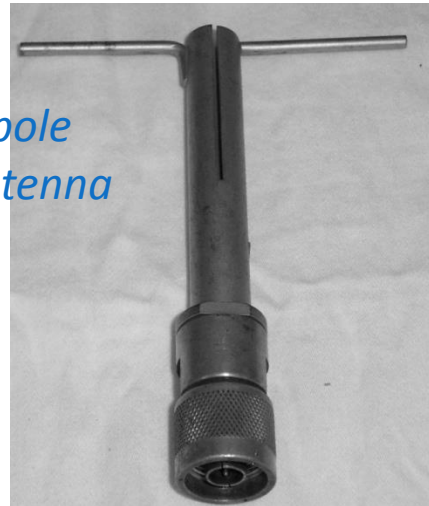
# Pictures of Antennas

## Wire, Horn and Conical Antennas

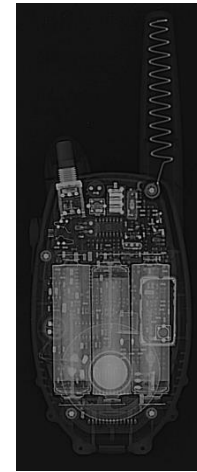
Monopole  
Radio  
Conical  
Antenna



Dipole  
Antenna



Helical  
Antenna



Horn  
Antenna



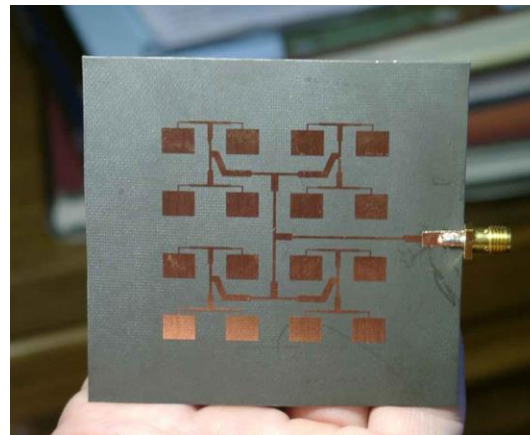
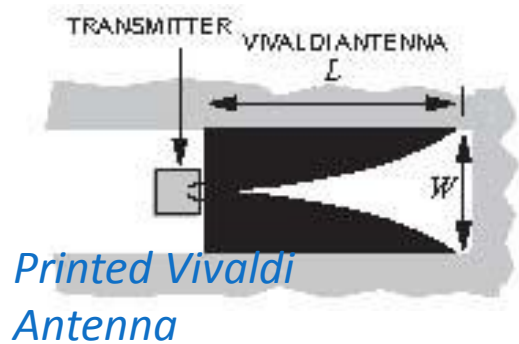
Conical Spiral  
Antenna



Disc-Cone  
Antenna

## Pictures of Antennas

## Printed Antennas and Yagi Arrays

*Microstrip Antenna Array**Yagi Antenna**Three-Sector  
Telephone Site*

## Pictures of Antennas

## Reflector Antennas



*Arecibo Observatory Reflector – The largest reflector on Earth (305 m)*



# Conclusion

- Applications operating in different RF bands.
- Guided and unguided propagation.
- Antenna miniaturization, efficiency improvement and multiband/wideband operation.
- Definitions of antenna.
- Pictures of some antenna types.