Microwave Engineering

Chapter 0
INTRODUCTION

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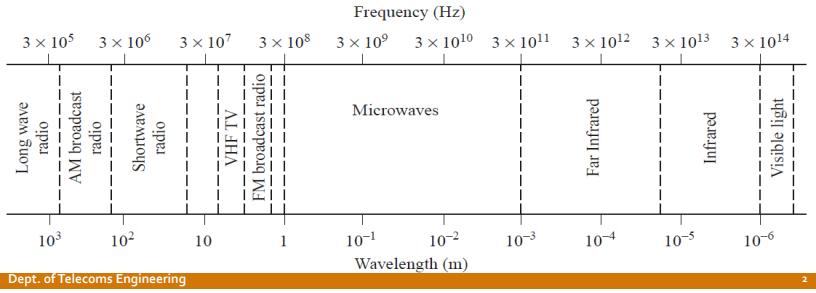
Microwave Engineering

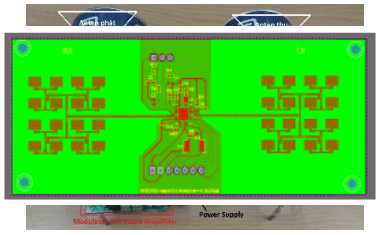
The field of radio frequency (RF) and microwave engineering generally covers the behavior of AC signals with frequencies in the range of 300 KHz to 300 GHz.

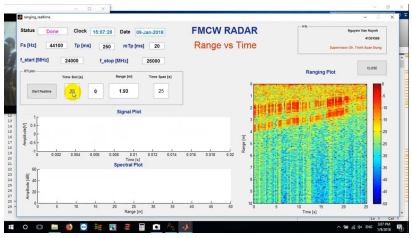
- RF signals: 300 KHz to 3 GHz Wavelength: 1 Km – 0.1m
- Microwave signals: 300 MHz – 300 GHz Wavelength: 0.1m – 1mm
- Millimeter-wave signals: 30 GHz – 300 GHz Wavelength: 10 mm – 1mm



Why Microwave Engineering?

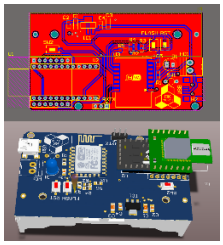
- Analysis methods developed in the previous courses (Electronic circuits) cannot be used to analyze, design high frequency circuits/problems: Radar, Sensing, RF Identification, Wireless Communications, Broadcasting, Positioning Systems, GPS, collision avoidance system, etc.
- How are the knowledge obtained in this course and previous courses including Electromagnetism, Signal and Systems, Circuit Analysis, Electronic Circuits are used to analyze and design modern Microwave systems.
- Demonstration of FMCW Radar System at 24GHz





Why Microwave Engineering?

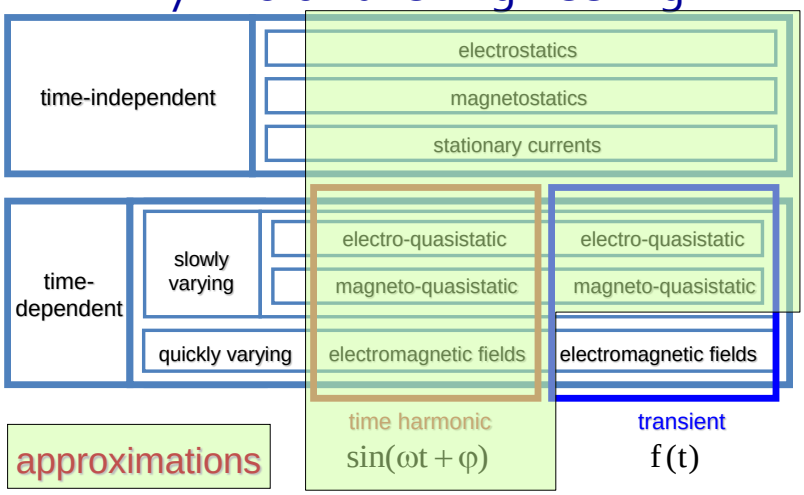
- How are the knowledge obtained in this course and previous courses including Electromagnetism, Signal and Systems, Circuit Analysis, Electronic Circuits are used to analyze and design modern Microwave systems.
- Demonstration of High accuracy Realtime UWB Indoor Positioning System



Why Microwave Engineering?

- Analysis methods developed in the previous courses (Electronic circuits) can not be used to analyze, design high frequency circuits/problems:
- Low frequency versus high frequency:
  - At low frequencies, an electrical circuit is completely characterized by the electrical parameters like resistance, inductance, capacitance etc. and the physical size of the electrical components plays no role in the circuit analysis.
  - As the frequency increases however, the size of the components becomes important. The voltage and currents exist in the form of waves. Even a change in the length of a simple connecting wire may alter the behavior of the circuit.

Why Microwave Engineering?



Course Outline

COURSE OUTLINE:

- The course introduces basic concepts and fundamental theories of circuit analysis at microwave frequencies, where the traditional analysis methods cannot be used. It is based on distributed element concepts and scattering matrices of multiple-port microwave networks.

- The course consists of 4 chapters:
  - Chapter 1: Introduction of transmission line theory, reflection coefficients, standing-wave ratio, line impedances.
  - Chapter 2: Smith chart and its application in microwave circuit analysis and design.
  - Chapter 3: Scattering Matrix and characteristics.
  - Chapter 4: Microwave Amplifiers.

Course Overview

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Textbook and References:

[1] David M. Pozar, Microwave Engineering, 4th edition, John Wiley & Sons, 2012.
[2] Vũ Đình Thành, Kỹ Thuật Siêu Cao Tần, NXBKHKT, 2003.
[3] Accompanying lecture notes.

Course Assessment

GRADING:

- **Homework and Exercises: 20%**
- **Mid-term Exam: 30%**

Closed book and One single-side A4 note sheet and Smith Chart are allowed

- **Final Exams: 50%**

Closed book and One double-side A4 note sheet and Smith Chart are allowed

Learning Outcomes

After completing the course, students should be able to:

- Explain the differences between lumped and distributed components in microwave circuits.
- Derive the telegrapher's equations and their solutions.
- Understand the concept of incident and reflected waves including voltages, currents and powers.
- Calculate and analyze parameters of wave propagation on transmission lines such as reflection coefficient, line impedance, standing wave ratio and standing wave ratio.
- Calculate voltage, current and power (incident, reflected and total) on T.L.
- Understand and use the Smith Chart to calculate and analyze parameters of transmission lines.
- Use the Smith Chart to design impedance matching networks.
- Understand the definition and determine scattering parameters of simple microwave multi-port networks.

Q&A