

Credits: 6

Code: ING-INF/02 Matter: Microwave engineering Main language of instruction: Italian Other language of instruction: English

Teaching Staff

<u>Head instructor</u> Prof. Alessio Monti - alessio.monti@unicusano.it

Introduction

1. Objective of the course :

The course provides the fundamentals about the guided propagation of the electromagnetic field and the basic knowledge of passive microwave components and of the electromagnetic theory behind their operation. Particular emphasis is given to the methods required to understand the behavior and to design the most common guiding structures working at microwave frequencies. The fundamentals for the design of microwave components and networks are also provided.

Objectives

2. Course Structure:

The course is organized in five subjects. The first subject summarizes the main results of the electromagnetic theory and introduces the classification and the main uses of microwaves. The second subject focuses on the analytical tools needed for the characterization of the electromagnetic guiding structures. The third and fourth subject analyses the most common guiding structures constituted by one or more conductors and provide the respective design tools. Finally, the fifth subject is aimed to the analysis and to the design of microwave and millimeter-wave networks.

Competencies:

• Understanding of the physical phenomena regulating the guided propagation of the electromagnetic field and of the relative mathematical tools;



• Ability to choose and to design a proper microwave guiding structure with respect to the desired application and the frequency range;

• Ability to analyze and to synthesize microwave components and networks both in waveguide and printed circuit technologies.

Syllabus

3. Programme of the course:

Subject 1. Introduction

Fundamentals of electromagnetic theory. Maxwell equations. Constitutive relationships of materials. Introduction to microwave engineering. Electromagnetic spectrum. Examples of guiding structures.

Subject 2. General considerations about microwave guiding structures

Maxwell equations in transverse form. TE, TM and TEM waves. Boundary conditions. Eigenvalues and eigensolutions. Phase, energy and group velocities. Waves Attenuation. Waves orthogonality.

Subject 3. Rectangular and circular waveguide

TE and TM waves in rectangular waveguide. Dominant and highorder modes in rectangular waveguide. Bessel functions. TE and TM waves in circular waveguide. Dominant and high-order modes in circular waveguide.

Subject 4. Guiding structures with more than one conductor

Guiding structures with more than one conductor and closed metal cladding. Coaxial cable. Stripline. Microstrip transmission-line.

Subject 5. Analysis and design of microwave networks

Introduction. Transmission-line model of the guided modes. Microwave networks. Matrices for microwave networks. Passive microwave components.

Evaluation system and criteria

The assessments of course is based on the following criteria:

I) Final exam (84 %)



II) Homework (16 %)

The final exam consists of three parts: two numerical exercises and one open question.

The homework consists in the writing of a technical report containing the results of numerical simulations of relevant structures.

Bibliography and resources

- *4. Materials to consult:*
- Lecture notes
- Recorded and live lectures

5. Recommended bibliography:

- David M. Pozar, "Microwave Engineering", 4rd edition, John Wiley & Sons, Inc.

- Robert E. Collin, "Foundations for Microwave Engineering", 2nd edition, Wiley-IEEE Press.