# COMMUNICATION ENGINEERING AND ELECTRONIC TECHNOLOGIES

(Lecce - Università degli Studi)

## Insegnamento ELECTROMAGNETIC SOLUTIONS FOR HI-TECH

GenCod A005494

**Docente titolare** Luca CATARINUCCI

**Docenti responsabili dell'erogazione**
Luca CATARINUCCI, GIUSEPPINA MONTI

**Insegnamento** ELECTROMAGNETIC SOLUTIONS FOR HI-TECH

**Insegnamento in inglese** ELECTROMAGNETIC SOLUTIONS FOR

**Settore disciplinare** ING-INF/02

**Corso di studi di riferimento** COMMUNICATION ENGINEERING AND

**Tipo corso di studi** Laurea Magistrale

**Crediti** 6.0

**Ripartizione oraria** Ore Attività frontale: 54.0

**Per immatricolati nel** 2020/2021

**Erogato nel** 2021/2022

**Anno di corso** 2

**Lingua** ITALIANO

**Percorso** PERCORSO COMUNE

**Sede** Lecce

**Periodo** Secondo Semestre

**Tipo esame** Orale

**Valutazione** Voto Finale

**Orario dell'insegnamento**
https://easyroom.unisalento.it/Orario

BREVE DESCRIZIONE DEL CORSO

The course aims at introducing and deeply investigating some of the applicative aspects of Electromagnetics which are more appealing to the student and more relevant from the point of view of their use in the labour market.
Starting from general projects focused on RF aspects of new wireless technologies, the basic concepts functional to their development will be deepened, the final projects will be executed and skills useful for the practical realization and tests of the designed devices will be developed.
"Electromagnetic Solutions for Hi-Tech" focuses on various topics in common with other courses belonging to the same scientific sector, but it remains a self-consistent course not bound by any prerequisites. Strategically, in "Electromagnetic Solutions for Hi Tech" qualitative and applicative aspects are highlighted and stressed, even though the approach keeps on being extremely rigorous.

PREREQUISITI

**For "CdL Ingegneria dell'Informazione" students:** Contents of "Fisica II" related to Maxwell's equations are needed.

OBIETTIVI FORMATIVI

At the end of the course the student should be able to:
- Apply the basic concepts of electromagnetism.
- Set up high frequency device designs based on requirements.
- Master (among others) the concepts of impedance matching, radiation diagram, gain, polarization, image theorem, filiform antennas.
- Enrich the knowledge (from the point of view of Electromagnetics) of consolidated (e.g. Wi-Fi and GSM), emerging (RFID UHF and HF, NFC, Bluetooth Low Energy), and approaching technologies (mm-Wave Wi-Fi , 5G).

METODI DIDATTICI

Frontal lessons, practical exercitations, laboratory activities.

MODALITA' D'ESAME

Oral exam. The oral exam is aimed at verifying the knowledge and understanding of the course topics acquired by the student (maximum overall duration: 45 minutes).

PROGRAMMA ESTESO

**PART 1**

**(25 hours, of which 16 hours of frontal lesson and 9 hours of laboratory activity)**.

Design, construction and test of waveguide antennas for Wi-Fi communication (each student will design and realize his own antenna): Notes on Wi-Fi technology. Preliminary design of a waveguide antenna for Wi-Fi links. Qualitative introduction of the basic concepts of electromagnetics useful for the project: distributed constant circuits, transmission lines; line-load matching; filiform antennas (dipole in l/2 and in l/4); method of images; radiation diagrams; directivity and gain; circular waveguides; TE and TM modes in waveguides. Vector Network Analyzer. Use of the Vector Network Analyzer for the measurement of some antenna properties. Final design, simulation, laboratory realization, measurement with Vector Network Analyzer and possible optimization. Test system design. Performance verification.

**PART 2**

**(6 hours, of which 4 hours of frontal lesson and 2 hours of laboratory activity)**

Analysis of panel antennas for GSM base radio stations: characteristics of GSM from the point of view of the antenna designer. Guidelines for the general design of a panel antenna for GSM base radio stations. Depth study of the basic concepts of electromagnetics useful for the project, including: linear arrays and planar arrays. 2D FDTD for GSM antennas.

**PART 3**

**(9 hours, of which 5 hours of frontal lesson and 4 hours of laboratory activity)**

Basic theory and examples about horn antennas, slotted waveguide antennas, and parabolic reflectors. The basic theory for analyzing aperture antennas will be presented, including Principle of Equivalence and radiated field derivation through 2D Fourier transform. Some examples of aperture antennas will also be analyzed by introducing the basic design equations.

A full-wave simulator commercial software will be used for analyzing some examples of aperture antennas. An experiment will be also developed.

**PART 4**

**(8 hours, of which 6 hours of frontal lesson and 2 hours of laboratory activity)**

Analysis and test of an electric field meter for UHF RFID signals. RFID technology: main aspects of the technology. Examples of application of RFID technology. Analysis of an electric field meter for the UHF band. Depth study of the basic concepts of electromagnetics useful for the project, including antenna reciprocity theorem, linear, circular and elliptical polarization, measurement of low and high frequency electromagnetic fields, conjugate matching, link budget, and measurement of the radiation pattern. Test of the meter in a practical case: checking RFID coverage in a real environment.

**PART 5**

**(6 hours of scientific seminars)**

Seminars from the business and research world. One to three seminars dealing with the design and use of emerging technologies are planned.

TESTI DI RIFERIMENTO

**Main course book:**

[1] Huang, Kevin Boyle, *Antennas: From Theory to Practice*, Wiley

**Other Suggested Bibliography:**

[2] G. Gerosa, P. Lampariello, *Lezioni di Campi Elettromagnetici*, Edizioni Ingegneria 2000
[3] A. Paraboni, *Antenne*, Mc Graw-Hill
[4] J. D. Kraus, *Antennas*, Mc Graw-Hill