COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2022 - 2023

GENERAL INFORMATION

Data of the subject	
Subject name	Electromagnetic Waves
Subject code	DEA-GITT-314
Mainprogram	Bachelor's Degree in Engineering in Telecommunication Technologies
Involved programs	Grado en Ingeniería en Tecnologías de Telecomunicación [Third year] Grado en Ingeniería en Tecnologías de Telecomunicación [Third year]
Quarter	Semestral
Credits	6,0 ECTS
Type	Optional
Department	Department of Electronics, Control and Communications
Coordinator	Pedro Olmos González
Office hours	Ask teacher before or after class

Teacher Information	
Teacher	
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

Prior knowledge required for student are the following: Electromagnetic fields, complex algebra, differential and integral calculus. Energy and electromagnetic power, resonance. Logarithmic units: decibel. Circuits analysys anfdfrequence response.

Course contents

Contents

Part 1: Transmission lines

The basic lines contained in the program are articulated around the fundamental concepts of electromagnetism.

Topic 1:Transmission lines

1.1 Transmission lines equations.

1.2 Line impedance

1.3 Reflection.

1.4 "S" parameters.

1.5 Smith char. Impedance matching using Smith char, lumped and distributed elements.

1.6 More common lines types; coaxial, bifilar, microstrip, stripline.

Part 2: Ondas guiadas.

Topic 2: Waveguides.

2.1 Wave equation resolution, electromagnetic resolution of transmission lines equations. Propagation modes.

2.2 Wave velocity. Phase and group velocity.

2.3 Rectangular waveguide.

2.4 Circular waveguide .

2.5 Coaxial waveguide , Upper modes.

2.6 Cavity and resonators.

Part 3: Free space waves.

Topic 3: Plane waves.

3.1 Uniform plane waves in free space. (Just a little review)

3.2 Plane waves polarization (Just a little review)

3.3 Plane waves in lossy medium.

3.4 Boundary conditions.

3.5 Reflection in dielectric medium.

Topic 4 :Radiación.

4.1 Spheric waves esféricas. Transmission basic equation. Link loss and depolarization.

4.2 Ground influence Reflection, diffraction, ground wave etc.

4.3 Atmospheric influence. Refraction. Atmospheric gases losses, water vapor, rain etc.

4.4 Ionospheric propagation. Faraday rotation.

4.5 Other types of propagation.

Part 4: Antennas.

Topic 5: Antennas

5.1 Basic concepts of antennas. Most important parameters.

5.2 Short antennas, short dipole and small loop.

5.3 Lineal antennas .

5.4 Arrays

5.5 Wide band antennas .

5.6 Aperture antennas, horns and parabolic. (2)

5.7 Diversity, smart antennas and MIMO system.

Part 5: Laboratory practices.

Practice 0: Learning and familiarization with radio frequency simulation programs.

Practice 1: Vector network analyzer and S parameters. Transmission lines

Practice 2: Antennas. Design, simulation and construction of an antenna using moments method and its measurement in the laboratory.

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Laboratory practices.	Compression of concepts. Application of concepts to the resolution of practical problems. Skilled in problem solving with the help of the appropriate laboratory material and specific software. Analysis and interpretation of the results obtained in the problems solved with a computer. Group work capacity. Presentation and written communication.	10 %
Final test	Understanding of concepts. Application of concepts to the resolution of practical problems. Analysis and interpretation of the results obtained in solving problems. Presentation and written communication	60 %
Intersemestral test	Application of concepts to the resolution of practical problems Presentation and communication in writing and in graphics mode.	20 %
Problems with S-parameter microwave simulators. (Practice 0)	Correctly solve the proposed problem with the help of radiofrequency simulation programs, imaginative or ingenious solutions will also be valued	10 %

Grading

The qualification in the **ordinary test** of the subject will be obtained as:

60% of the final exam grade. To pass the subject, a minimum grade of 5 will be required in the final exam. It will consist of two parts, theory and practice. To pass in average, you will need at least 3.5 points in each of the parts.

20% the inter-semester exam

10% laboratory works

10% individual works (práctice 0).

The grade in the **extraordinary test** for the subject will be obtained as:

80% of the mark of the extraordinary final exam. To pass the subject, a minimum grade of 5 will be required in said exam.

10% of laboratory work.

10% individual work (practice 0).

Students who have failed the subject and obtained a grade lower than 3.5 both in the laboratory or in the individual works will be examined in an extraordinary session.

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Reading and study of the theoretical contents in the notes	After every class	
Resolution of the proposed problems.	Weekly	
Delivery of the proposed problems.		Next week
Preparation of the tests that will be carried out during class hours.	After each topic	
Delivery of individual works (practice 0).	Entire course.	December 31
Preparation of the Final Exam.	December	
Preparation of laboratory reports.		15 days after each practice

BIBLIOGRAPHY AND RESOURCES

Basic References

- Introduction to RF Propagation. John S. Seybold, Ph.D. Ed: John Wiley & Sons, Inc.,
- Electromagnetic Waves and Antennas. Sophocles J. Orfanidis, ECE Department.

- Rutgers University. http://www.ece.rutgers.edu/~orfanidi/ewa
- Propagation of radio waves. M. Dolukhanov. Moscú 1995.
- Antenna theory. Analysis and design. Constantine A. Balanis.
- Antenna Physics: An introduction. Robert J. Zavrel, W7SX. ARRL.
- Radio System Design for Telecomunications (1-100 GHz). Roger L. Freeman. Ed: John Willey and Sons inc.