Universitat Autònoma de Barcelona

2023/2024

Radiation and Guided Waves

Code: 102683
ECTS Credits: 9

Degree	Type	Year	Semester
2500895 Electronic Engineering for Telecommunication	OB	2	1
2500898 Telecommunication Systems Engineering	OB	2	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

Gary Junkin

Prerequisites

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Objectives and Contextualisation

1. To use the formulation of Electromagnetic fields with agility, moving from the temporal domain to the phasor domain and vice-versa.
2. To understand the meaning of fields boundary conditions.
3. To use the general expression of the wave equation for the electric field in the frequency domain. Know the expression of the plane wave solution. Understand parameters such as phase constant, wavelength and phase velocity. Obtain the expression of the magnetic field associated with the wave from the electric field and vice versa. As well as the propagation direction vector.

4. To calculate the power density from the amplitude of the associated electric field. Manage the concept of power density. Analyze the type of polarization that a wave presents by studying the orientation of the electric field vector.
5. To manage the concept of reflection and transmission in cases of incidence perpendicular to the interface plane between dielectrics and between dielectric and conductor. Handle Snell's Laws in terms of the reflectance and refraction phenomena of the wave, applied to the problem of oblique incidence of the electromagnetic wave in the interface surface of two dielectric media
6. Analyze electrical circuits when the wavelength of the signal is comparable to the electrical size of the circuit. Know the distributed model of the transmission line by means of concentrated elements.

7. Know the general expression of the wave equation in voltages and currents in the phasor domain, as well as the expression of the solution. And relate parameters such as characteristic impedance, phase constant, wavelength and phase velocity. Learn to handle the approaches to lines of low losses but finite, and line without losses.
8. Understand that the presence of the reflected wave causes the appearance of the standing wave. Knowing how to propose the standing wave solution with open circuit and short circuit load impedance condition. Know how to shift the reflection coefficient and the impedance along a transmission line.
9. To calculate the power along the line. To understand that the power is constant along the line even if the voltage is not due to reflections.
10. To use the expressions that relate the elements of the circuital model of the transmission line with the geometry of the coaxial, microstrip and stripline lines.

Competences

Electronic Engineering for Telecommunication

- Communication
- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.
- Work in a team.

Telecommunication Systems Engineering

- Communication
- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.
- Work in a team.

Learning Outcomes

1. Adapt to multidisciplinary and international surroundings.
2. Adapt to multidisciplinary environments.
3. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
4. Define and calculate the fundamental parameters of a communications system that is related with the transmission and reception of waves.
5. Define the propagation and transmission mechanisms of electromagnetic and acoustic waves, as well as their corresponding transmission and receiving devices.
6. Develop the capacity for analysis and synthesis.
7. Manage available time and resources.
8. Manage available time and resources. Work in an organised manner.
9. Prevent and solve problems.
10. Reproduce experiments related with the propagation of waves and extract relevant information.
11. Resolve problems related with the propagation and transmission mechanisms of electromagnetic and acoustic waves, as well as their corresponding transmission and receiving devices.
12. Use the basic instruments of a communications laboratory.
13. Work cooperatively.

Content

Methodology

The following training activities will be developed:

Theory lessons where the main concepts of the subject will be explained, including examples and applications.
Practical classes of problems where the emphasis will be placed on aspects of the procedure in the resolution of problems.
Laboratory classes where the practical experimentation of the concepts developed in class will be shown.
Lessons in theory and problem-solving will take place simultaneously on the blackboard and slides with a computer.

Students will be provided with a collection of problems prior to their resolution in the class.

The professor will receive the students in his office during the specified tutoring hours, in order to solve doubts, expand concepts, etc.

It is highly recommended to attend these tutorials for better use of the grade.

Students will be given exams of previous calls.

It will be ensured that all the material of the subject is available to students through the Virtual Campus.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case and Problems seminars	15	0.6	6
Communications Lab sessions	30	1.2	3, 8, 10, 13
Master Class	30	1.2	5, 4, 6, 11
Type: Supervised			
Communications Lab tutorials	15	0.6	9
Radiation and Guided Waves Tutorials	15	0.6	9
Type: Autonomous			
Individual study	50	2	5, 4
Prepare for the Lab sessions. Make the report. Communications Lab.	30	1.2	1, 2, 8, 11, 13, 12
Problem solving and case study	15	0.6	11

Assessment

EXAM: Provide 60% of the total qualification.

REVIEW 1: Test of contents part of Radiation. (30%)

REVIEW 2: Test of contents part of Transmission line (30%)

RECOVERY EXAM: Retrieve the Theory part (REVIEW 1 and REVIEW 2).

To participate, the student must have previously evaluated activities that involve a minimum of 2/3 of the final mark .

Since the laboratory is not recoverable, it is necessary to attend at least 1 of the two EXAMS of Contents.

Laboratory Practicum (Build 40% of the note)

There are 10 laboratory-grade sessions, representing 60% lab report (6% each contribution).

There are 8 EVAL evaluations-SIMAL , provide 40% laboratory qualification (5% each contribution)

The lab is not recoverable.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
EXAM 1	30%	1	0.04	5, 4, 6, 11
EXAM 2	30%	1	0.04	6, 10, 11
Evaluation second-attempt	60%	3	0.12	3, 5, 6, 8, 11
Lab Practicum	40%	20	0.8	1, 2, 3, 7, 8, 9, 10, 11, 13, 12

Bibliography

DIOS,F., ARTIGAS,D., RECOLONS,J., COMERON, A.,CANAL,F. Campos electromagnéticos. Edicions UPC,1998

RAMO, S., WHINNERY, J. & VAN DUZER, T. Fields and waves in communication electronics. John Wiley and Sons, 1994

BARA, J. Circuitos de microondas con líneas de transmisión. Edicions UPC, 1996.

DAVID M. POZAR, Microwave Engineering, John Wiley & Sons, 2005

Software

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