Course guide
230013 - RP - Radiation and Propagation

Last modified: 25/05/2023

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS

Good capability to operate complex numbers. Knowledgement of Electromagnetic Fields and Waves and Circuit Theory.

REQUIREMENTS

ELECTROMAGNETICS WAVES - Precorequisite

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
4. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 2. To identify, model and pose problems starting from open situations. To explore the alternatives to solve the problem and to choose the best one according to a justified criterion. To know-how to make approaches. To propose and implement methods to validate the solutions. To have a complex system vision and of interactions among complex systems components
5. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.

Transversal:
1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
3. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

Lectures
Laboratory work and exercises
Laboratory reports
Self study (home work)
Short tests: Control exercises, grouped by subject, distributed thought out the course.
Long tests (Mid-term and Final exam)

LEARNING OBJECTIVES OF THE SUBJECT

Based on the knowledge of Electromagnetic Fields and Lineal Circuits Theory, the students will learn the fundamentals of transmission media, both, those based on guided and radiated electromagnetic fields

Learning results:
Knowledgement of electromagnetic wave transmission, both guided and radiated.
The student knows how to compute the fundamental parameters of a communication system, understands the concept of signal to noise ratio and knows how to compute it.

STUDY LOAD

Type	Hours	Percentage
Hours small group	13,0	8.67
Hours large group	52,0	34.67
Self study	85,0	56.67

Total learning time: 150 h

CONTENTS

Theme 1. Introduction and basic concepts

Description:
Electric energy and power; Circuits in Sinusoidal Steady State; Units and logarithmic magnitudes (dB and Neper)

Related activities:
Laboratory practice 1

Full-or-part-time: 12h
Theory classes: 4h
Laboratory classes: 2h
Self study : 6h

Theme 2. Transmission lines

Description:
Definition and usual geometries. Time domain: voltage and current waves, reflection coefficient, transients and pulses. Sinusoidal Steady State: Voltage, current, impedance and reflection coefficient. Propagation constant and characteristic impedance. Input impedance. Power in the transmission line. Standing waves.

Related activities:
Laboratory practices 2 and 3

Full-or-part-time: 44h
Theory classes: 16h
Laboratory classes: 4h
Self study : 24h

Theme 3. Impedance measurement and matching networks

Description:
Polar representation of the reflection coefficient. Impedance measurement. Matching networks: discrete element networks, quarter wavelength transformers, transmission line section+stub.

Related activities:
Laboratory practice 4

Full-or-part-time: 14h
Theory classes: 8h
Self study : 6h

Theme 4. Theory of guided waves

Description:
Transversal and axial fields. Propagation modes, cutoff frequency, group and phase velocity, dispersion. The fundamental mode in the rectangular waveguide: Cutoff frequency, guide wavelength, dispersion, power, mode impedance. Standing waves, equivalent transmission line.

Related activities:
Laboratory practice 4

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

Theme 6. Antenna fundamentals

Description:
Basic concepts: power and polarization of plane waves , basic antenna configurations, the directivity concept, spherical coordinates and solid angle. Transmission antenna parameters: Circuit model, radiated power, radiated power density, radiation intensity, radiation diagram, directivity, equivalent solid angle. Reception antenna parameters: circuit model, effective area, effective lenght. Noise in reception: antenna temperature, equivalent noise temperature, noise to signal ratio (NSR).

Related activities:
Laboratory Practice 5

Full-or-part-time: 46h
Theory classes: 18h
Laboratory classes: 2h
Self study : 26h

GRADING SYSTEM

-Final exam: 60% (85% if the grade of continuous assessment is lower)
-Continuous assessment: 25%.
-Laboratory: 15%
Laboratory practices are not reevaluable
Two generic skills are evaluated within this subject:
-Student capability to undertake experimental work and handle laboratory instruments

EXAMINATION RULES.

Calculator: In order to undertaken the tests and exams within this subject, a calculator that operates complex numbers is required. Programmable devices, cameras and any wireless device are strictly forbidden during tests and exams.

BIBLIOGRAPHY

Basic:
- Dios, F. [et al.]. Campos electromagnéticos [on line]. Barcelona: Edicions UPC, 1998 [Consultation: 12/01/2015]. Available on: http://hdl.handle.net/2099.3/36160. ISBN 8483012499.
- Bará, J. Circuitos de microondas con líneas de transmisión [on line]. Barcelona: Edicions UPC, 1994 [Consultation: 06/02/2015]. Available on: http://hdl.handle.net/2099.3/36161. ISBN 9788489636552.
- Cardama, Á. [et al.]. Antenas [on line]. 2a ed. Barcelona: Edicions UPC, 2002 [Consultation: 09/02/2015]. Available on: http://hdl.handle.net/2099.3/36797. ISBN 8483016257.

Complementary:
- Pozar, D.M. Microwave engineering [on line]. 4th ed. Hoboken: Wiley, 2012 [Consultation: 10/10/2022]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=2064708. ISBN 9780470631553.
- Ramo, S.; Whinnery, J. R.; Van Duzer, T. Campos y ondas: aplicaciones a las comunicaciones electrónicas. Madrid: Pirámide, 1974. ISBN 8436800060.