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230013 - RP - Radiation and Propagation

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2019

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: FRANCISCO JAVIER FÀBREGAS CÀNOVAS

Others: - FRANCISCO JAVIER FABREGAS CANOVAS - MERCEDES MAGDALENA VALL-LLOSSERA FERRAN - IGNASI CORBELLA SANAHUJA - JORDI MALLORQUÍ FRANQUET

Prior skills

Good capability to operate complex numbers

Degree competences to which the subject contributes

Generical:

6. 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
7. 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. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. 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.
4. EFFECTIVE USE OF INFORMATION 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.
5. 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.

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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

Study load

Total learning time: 150h	Hours large group:	52h	34.67%
	Hours small group:	13h	8.67%
	Self study:	85h	56.67%

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Content

(ENG) 1. Introduction and basic concepts

Learning time: 11h 27m

Theory classes: 3h 27m
Laboratory classes: 2h
Self study : 6h

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

Related activities:
Laboratory Work I

(ENG) 2. Transmission lines

Learning time: 41h 16m

Theory classes: 13h 16m
Laboratory classes: 4h
Self study : 24h

Description:
Definition and usual configurations. Time domain: voltage and current waves, reflection coefficient, transients and pulses. Sinusoidal Steady State: Voltage, current, impedance and reflection coefficient. Propagation constant and wave impedance. Input impedance. Power in the transmission line. Voltage standing waves (VSW).

Related activities:
Laboratory Works II and III

(ENG) 3. Impedance measures and matching networks

Learning time: 10h 33m

Theory classes: 4h 33m
Self study : 6h

Description:
Polar representation of the reflection coefficient. Impedance measures. Matching networks: "L" networks, quarter wavelength transformers, transmission line section+stub.

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(ENG) 4. Theory of guided waves

Learning time: 20h 11m

Theory classes: 6h 11m
Laboratory classes: 2h
Self study : 12h

Description:
The wave equation. Transversal and axial fields. Propagation modes in conductive guides (TEM, TE, TM):cut-off frequency, classification of modes, dispersion, group and phase velocity. The fundamental mode in the rectangular waveguide: standing waves, equivalent transmission line.

Related activities:
Laboratory Work IV

(ENG) 5. Dielectric guides: the optical fiber

Learning time: 15h 27m

Theory classes: 5h 27m
Self study : 10h

Description:
Basic parameters of the dielectric guide. Multi-mode propagation: Snell Law, total internal reflection, pulse widening, maximum bit rate. Single-mode propagation: modal analysis of the dielectric slab, wave dispersion equation, fundamental mode. Fiber optics basics. Attenuation.

(ENG) 6. Antenna fundamentals

Learning time: 45h 06m

Theory classes: 14h 06m
Laboratory classes: 5h
Self study : 26h

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 Work V

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Qualification system

-Final exam: 60%
-Continuous assessment: 25%.
-Laboratory work and reports: 15%

Two generic skills are evaluated within this subject:
-Third language (low level)
-Student capability to undertake experimental work and handle laboratory instruments

Regulations for carrying out activities

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:

Ramo, S.; Whinnery, J. R.; Van Duzer, T. Campos y ondas: aplicaciones a las comunicaciones electrónicas. Madrid: Pirámide, 1974. ISBN 8436800060.