Course guides
230912 - EAFO - Applied Electromagnetism and Photonics

Last modified: 29/04/2020

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

Degree: BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018). (Compulsory subject).

Academic year: 2020 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: María Concepción Santos Blanco

Others: Dios Otin, Victor Federico

PRIOR SKILLS

Differential equations. Operations with complex numbers. Vector analysis: scalar and vector fields, differential operators, coordinate systems. Electromagnetism: sources of the electric and magnetic field. Gauss's law, Ampère's law, Faraday's law.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE3. (ENG) GREELC:Comprensió i domibbi dels conceptes bàsics sobre les lleis generals de la macànica, termodinàmica, camps i ones i electromagnetisme i la seva aplicació per a la resolució de problmes propis de l'enginyeria. (Mòdul de formació bàsica).

Generical:
CG5. (ENG) GREELEC: Coneixements per a la realització de medicions, càlculs, taxacions, peritacions, estudis, informes, planificació de tasques i treballs anàlegs en l'ambit específic de la telecomunicació.

Basic:
CB2. (ENG) GREELEC: Que els estudiants sàpiguen aplicar els coneixements adquirits al seu treball o vocació d'una forma professional i tinguin las competències que solen desmostrar-se per mitjà de l'elaboració i defensa d'arguments i la resolució de problemes dins de la seva àrea d'estudi.

TEACHING METHODOLOGY

The course provides a general view of the nature of electromagnetic waves, the characteristics of their propagation, both in free space as in guides and fibers, and their interaction with material media, dielectrics and conductors. There is a rich range of phenomena that are at the base of current technologies related to the transmission of information and of sensors and user interfaces. It is intended to give a fundamentally practical vision, but without neglecting a sufficiently general mathematical description, as to allow the student to understand the operating principles of other emerging technologies. The course is complemented by an introductory explanation to laser emitters and photodetection. Explanations are combined in the classic exhibition format, classes with transparencies, proposed exercises and laboratory work in which students have to obtain or confirm results by combining the experimental measures with the theory learned.

LEARNING OBJECTIVES OF THE SUBJECT

The basic objective is for students to be able to express, in an appropriate physical-mathematical language, situations that may be related to the propagation, reflection, transmission, diffraction or guidance of electromagnetic waves, as well as the various wave interference problems that may be encountered.

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

Wave equation. Plane waves

Description:
Wave equation. Types of electromagnetic waves. Permanent sine wave regime and phasor notation. Plane waves. Wave number. Characteristic relationships. Poynting vector.

Full-or-part-time: 12h
Theory classes: 9h
Laboratory classes: 3h

Plane wave polarization

Description:
Polarization types and mathematical description. Orthogonal polarizations. Devices for polarization control.

Full-or-part-time: 9h
Theory classes: 6h
Laboratory classes: 3h

Plane waves in lossy media

Description:
Mechanisms of losses. Complex permitivity. Propagation and attenuation coefficients. Good conductor. Film effect.

Full-or-part-time: 4h
Theory classes: 4h

Incidence of plane waves on the separation surface of two media

Description:
Incidence on perfect conductor. Incidence on dielectrics. Fresnel formulas. Brewster angle. Total internal reflection and evanescent field. Normal incidence and multilayer.

Full-or-part-time: 12h
Theory classes: 7h
Laboratory classes: 5h

Waveguides

Description:
Waveguides and transmission lines. Waveguides with metallic walls. Propagation modes. Modes TE and TM. Dispersion equation. Fundamental mode. Dielectric waveguides.

Full-or-part-time: 8h
Theory classes: 7h
Laboratory classes: 1h

Radiation fundamentals

Description:
Radiation theory. Electric and magnetic dipoles. Antenna parameters. Antenna arrays.

Full-or-part-time: 7h
Theory classes: 7h

Optical detection

Description:
Photoelectric and photoconductive effect. Photodiodes PIN and avalanche diodes. Signal to noise ratio. Minimum detectable power. Noise Equivalent Power.

Full-or-part-time: 7h
Theory classes: 6h
Laboratory classes: 1h

Laser fundamentals

Description:
Light-matter interaction: absorption, spontaneous and stimulated emission. Optical resonators. Longitudinal and transversal modes. Emission linewidth.

Full-or-part-time: 6h
Theory classes: 6h

GRADING SYSTEM

Continuous evaluation: 30%
Laboratory practices (compulsory): 10%
Final exam: 60%

EXAMINATION RULES.

Resolution of problems related to the topics studied. The standards are the general ones at the UPC.

BIBLIOGRAPHY

Basic:
- Reitz, J.R.; Mildford, F.; Christy, R. Foundations of electromagnetic theory. 4th ed. Reading, Mass: Addison-Wesley, 1993. ISBN 9780321581747.
- Dios, F. ... [et al.]. Campos electromagnéticos [on line]. Barcelona: Edicions UPC, 1998 [Consultation: 10/07/2019]. Available on: http://hdl.handle.net/2099.3/36160. ISBN 8483012499.
- Someda, C.G. Electromagnetic waves. 2nd ed. Boca Raton, FL: CRC/Taylor & Francis, 2006. ISBN 9780849395895.