Last update: 06-05-2019

230470 - ONEMAG - Electromagnetic Waves

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 ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: VICTOR FEDERICO DIOS OTIN

Others: JUAN-MANUEL RIUS CASALS

Opening hours

Timetable: By appointment

Prior skills

Foundations on Electriciy and Magnetism, both in free space and in dielectric and magnetic media. Waves, vectorial analysis and ordinary differencial equations

Requirements

The course of Electromagnetism.

Degree competences to which the subject contributes

Specific:

1. Knowledge of electromagnetism laws. Ability to solve engineering problems: magnetism, electricity and electrical technology, electromagnetic waves and wave optics.
2. Knowledge of the mechanisms of propagation and transmission of electromagnetic waves. Ability to analyze and use transmitter and receiver devices.

Generical:

1. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:

2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology

The main weight of the course is set on the theory and problems sessions, without forgetting the important practical applications of the subject. The MODDLE platform is used as the usual communication mean with the students.

Learning objectives of the subject

The main goal is provide students with a clear insight, visual and also mathematic, about the phenomena associated with wave propagation, in free space and through transmission line of any type.

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Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

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Content

1. Electromagnetic waves in free space

Learning time: 30h

Theory classes: 7h
Practical classes: 5h
Guided activities: 2h
Self study : 16h

Description:
1.1 Wave equation. Wave functions.
1.2 Plane waves and spherical waves.
1.3 Plane waves in steady sinusoidal state. Uniform and non uniform plane waves. Wave impedance.
1.4 Power and power density associated at the wave.
1.5 Polarization. Types of polarization. Elements for the control of polarization: polarizer and retarder plates.
1.6 Plane waves in lossy media.

2. Incidence of waves in separation surfaces

Learning time: 30h

Theory classes: 7h
Practical classes: 5h
Self study : 18h

Description:
2.1 Incidence in dielectrics and in conductors. Coefficients of reflection and transmission. Fresnel formulas. Brewster's angle.
2.2 Total reflection.
2.3 Standing waves. Totally and partially standing waves. Standing wave ratio. Anti-reflection coatings.
2.4 Reflection in multilayer coatings. Generalized reflection coefficient. Generalized wave impedance.

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3. Transmission lines

Learning time: 26h

Theory classes: 7h
Practical classes: 4h
Guided activities: 1h
Self study : 14h

Description:
3.1 Introduction: problems in circuit theory associated to high frequencies. Necessity of a new formulation. Types of transmission lines
3.2 TEMz waves in a transmission line of two conductors. Telegraphist?s equation
3.3 Model of distributed parameters. Circuit parameters per unit length.
3.4 Wave propagation in a transmission line. Propagation velocity and characteristic impedance.
3.5 Terminated transmission line without losses. Reflection coefficient, standing wave ratio and input impedance. Smith chart.
3.6 Generator and load mismatching. Power transmission and conjugated impedance matching.
3.7 Losses in transmission lines.

4. Waveguides and optical fibers

Learning time: 32h

Theory classes: 9h
Practical classes: 5h
Self study : 18h

Description:
4.1 Waveguides with conducting walls
Modes of propagation in a guide. TE and TM modes. Wavelength in the guide. Cut-off frequency of a mode.
4.2 Rectangular conducting waveguides
Propagation modes. Dispersion curves. Transmitted power
4.3 Resonators
4.4 Plane dielectric waveguides
Guided and radiation modes
4.5 Optical fibers. Fiber structure. Fiber types. Propagation modes. Dispersion curves.

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5. Foundations of radiation	Learning time: 32h Theory classes: 9h Practical classes: 5h Self study : 18h

Description:
5.1 Antenna parameters and transmission equation.
5.2 Radiated and induced fields.
5.3 Far field approximation. Significance of the radiation vector.
5.4 Elemental antennas: electric and magnetic dipoles
5.5 Images theory
5.6 Antenna arrays

Qualification system

The final mark is given by three figures: the final exam (EF) , the middle term exam (EP) and the evaluation of specific works realized during the course (TE).

The final mark is given by: Max {0.90*EF+0.10*TE , 0.55*EF + 0.35*EP + 0.10*TE }

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.

Cheng, D.K. Fundamentos de electromagnetismo para ingeniería. Wilmington, Delaware: Addisson-Wesley Iberoamericana, 1997. ISBN 9684443277.

Pozar, D.M. Microwave engineering. 4th ed. Hoboken: Wiley, 2012. ISBN 9780470631553.

Complementary:

Reitz, J.R.; Milford, F.J.; Christy; R.W. Fundamentos de la teoría electromagnética. 4a ed. Wilmington: Addisson-Wesley Iberoamericana, 1996. ISBN 020162592X.

Hecht, J. Understanding fiber optics. 5th ed. Upper Saddle River: Prentice Hall, 2006. ISBN 0131174290.

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.