Electromagnetic fields and waves

Academic Year: (2023 / 2024) **Review date: 12/02/2024 11:19:38**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: RAJO IGLESIAS, EVA

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I and Physics II, 1st year
Differential Equations, 2nd year
Complex variable and transforms, 2nd year
Electromagnetism and Optics, 2nd year
Signals, systems and circuits, 2nd year

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Analyze and synthesize basic problems related to physics and engineering, solve them and communicate them efficiently.
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CG6. Develop new products and services based on the use and exploitation of new technologies related to physical engineering.
CE12. Understand and handle the mechanisms of propagation and transmission of electromagnetic waves both in free space and guided, including concepts of wave optics, and the corresponding transmitting and receiving devices.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.

RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them.
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking.
RA3. To be able to search for, collect and interpret relevant information and data to back up their

conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study.
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction: review of the Maxwell Model. Harmonic time variation. Phasors. Pointyng's theorem.
2- Fundamentals and characteristics of waves. Wave equation. Plane waves and cylindrical waves. Transmission and reflection in different scenarios: standing waves.
3- Guided waves: - waveguides, transmission lines and Smith chart.
4- Radiated waves: - radiation integral, antenna parameters, link budget.

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

LABS (1 ECTS)
There will be four labs:
LAB 1:
Introduction to CST simulation software and visualization of phenomena related to plane wave
LAB 2:
Waveguide simulation and study of guided wave characteristics
LAB 3:
Transmission lines. Design of a component with the CST software.
LAB 4:
Design and simulation of an antenna (dipole or patch).

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.60% of the final grade.
SE2. CONTINUOUS EVALUATION. Result of labs and midterm exams. 40%.

BASIC BIBLIOGRAPHY

- C.A. Balanis Advanced engineering electromagnetics, John Wiley and Sons, second edition, 2012

- D. K. Cheng Fundamentals of Engineering Electromagnetics, Prentice Hall, Second Edition , 1989

- Ramo, S., J. R. Whinnery and T. Van Duzer Fields and Waves in Communication Electronics, John Wyley and Sons, Third Edition, 1994

ADDITIONAL BIBLIOGRAPHY

- C.T.A. Johnk Engineering Electromagnetic Fields and Waves, Wiley, Second Edition, 1988

- R.F. Harrinton Time.Harmonic Electromagnetic Fields, MacGraw-Hill Book Company, 2001

- V.V. Nikolski Electrodinámica y propagación de ondas de radio, Editoria MIR, 1973