UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

RADIATED ELECTROMAGNETIC WAVES

Enrollment year	2019/2020
Academic year	2021/2022
Regulations	DM270
Academic discipline	ING-INF/02 (ELECTROMAGNETIC FIELDS)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	ELECTRONIC AND COMPUTER ENGINEERING
Curriculum	Elettronica
Year of study	3°
Period	2nd semester (07/03/2022 - 17/06/2022)
ECTS	6
Lesson hours	55 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	PERREGRINI LUCA (titolare) - 6 ECTS
Prerequisites	To successfully follow the course, students must have the following knowledge of mathematics and physics and have mastered the use of the following calculation tools: complex numbers, vector algebra, differential operations on scalar and vector fields, divergence theorem, systems of Cartesian and spherical coordinates; concept of force, work, energy, power, concept of field, charge, current, electric and magnetic polarization, electrostatic and magnetostatic fields in vacuum and in matter, Maxwell's equations, unit of measurement of physical quantities in the MKSA system. The topics of the first "Guided Propagation" module of the course are also a prerequisite for this didactic module.
Learning outcomes	The Radiated Propagation module represents the second part of the Electromagnetic Fields and Circuits course. The purpose of the course is to provide students with basic information on the propagation of

	electromagnetic waves both in waveguides and in free space. In addition, the student will be presented with the antennas and their properties. At the end of the course, the student is expected to be able to design simple waveguide or coaxial cable connections, appropriately sizing these systems to avoid electrical discharges, overheating and unwanted reflection phenomena. Furthermore, the student will have to acquire the ability to size a transceiver system, choosing the most appropriate antennas and evaluating the link budget in a simplified way.
Course contents	1. Waveguides - Formulation of the calculation of TE, TM modes in metallic guides: modal fields, modal impedance, cutoff frequency, normalization. Wavelength of cut, attenuation due to the conductor and the dielectric. Rectangular waveguides: expression of the normalized TE and TM modal fields, TE10 mode and formula of the attenuation due to the conductor for the TE10 mode. Circular waveguide: normalized modal fields, fundamental mode TE11. TEM modes. Coaxial cable and planar lines. Modal development. Dispersion and group velocity 2. Radiation - Lorentz potentials and their integral representation in the case of a source of limited size. Long distance approximations in the vacuum case. Field in the radiation zone. Intensity of radiation and radiated power. Elementary dipole. Circular loop. Dipoles of a length comparable to the wavelength. Radiation in a low-loss medium. Boundary conditions. Uniqueness theorem. Radiation in the presence of a conductive plane. Radiation from an aperture. Rectangular aperture illuminated uniformly. 3. Antennas - Characteristic parameters of transmitting antennas. Main types of antennas: dipoles, half-dipoles, resonant slots, truncated guides and horns. Antenna arrays. Linear arrays. Parabolic antennas. Reciprocity theorem. Receiving antennas. Effective area and polarization factor. Friis formula.
Teaching methods	Lessons (hours / year in the classroom): 30 Exercises (hours / year in the classroom): 25 Practical activities (hours / year in the classroom): 0
Reccomended or required readings	G. Conciauro, Introduzione alle onde elettromagnetiche, McGraw-Hill, 1993. G. Conciauro, L. Perregrini, Fondamenti di onde elettromagnetiche, Medea Edizioni, 2015 Slides provided by the teacher
Assessment methods	The exam consists of a written test and an oral test, to be taken in the same session: only those who have achieved at least 15/30 in the written test are admitted to the oral test. On request, students can be exempted from the oral test, obtaining the mark acquired in the written test (if between 18/30 and 24/30) or with the score of 24/30 (if the mark of the written exam exceeds 24/30). The average of the marks obtained in the two modules constitutes the final grade of the exam.
Further information	
Sustainable development	

goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile