Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Advanced Electromagnetics and Scattering (acronym: AE&S)
TEACHER NAME(S)	**Fabrizio Frezza**
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Teacher meeting	Any day, by appointment
Teacher office address	Università "La Sapienza" di Roma, Dipartimento di Ingegneria dell'Informazione, Elettronica e Telecomunicazioni (DIET), Via Eudossiana 18, 00184 Roma, Italy, bank building RM032, 3rd floor, room no. 319
DISCIPLINE (SSD)	Electromagnetic Fields (ING-INF/02)
Semester (1-4)	4
Credits (CFU/ECTS)	6
Lecture hours (h)	54
Prerequisite and learning activity	Basic Electromagnetics; Physics, Algebra, Calculus, Fourier transform
Teaching language and method	English; lectures, exercises and homeworks
Assessment method	Oral examination
SUBJECT WEBSITE	bit.ly/FabrizioFrezzaLaboratory

OBJECTIVES

The course is aimed at presenting an overview of some advanced topics in Electromagnetics, of considerable importance for the applications. Key instruments extensively used for their physical intuition and representative power are the modal expansion with the relevant equivalent distributed circuits, and the plane-wave spectra. The concepts of Green's function and integral representation are also studied in depth. Canonical scattering problems are finally presented, and the relevant numerical techniques for the simulation of complex structures are introduced.

OUTCOMES (Dublin descriptors: knowledge, understanding, explain, skill, ability)

Successful students will be able to have an overall vision of modern electromagnetics, with particular reference to the unifying methodological aspects and to the mathematical techniques employed, which will allow them to easily find their bearings in successive study or in job positions, due to the great generality of the faced themes. In particular, the students will have understood in depth the principal concept of guided and free propagation, as well as the approach to the scattering problem, solved both in closed form (canonical problems) and numerically.

PROGRAM CONTENT

Planar guiding structures, equivalent transmission lines for two-dimensional waveguides. Non-homogeneous wave types: surface wave, lateral wave, leaky wave, Zenneck wave, plasmons. The transverse-resonance method and applications. The effective-dielectric-constant method for three-dimensional waveguides. The spectral-domain method for the study of general planar stratified structures; integral equations for the currents: numerical solution with the method of moments. Spectral decomposition of the fields radiated by an aperture. Asymptotic evaluation of integrals: integration by parts, the stationary-phase method. Computation of the far field. General introduction to electromagnetic scattering and review of principal applications. Canonical problems: scattering from cylindrical structures. Simulation of generic two-dimensional scatterers. Scattering from periodical structures. Three-dimensional scattering.

REFERENCES AND MATERIAL

• F. Frezza, Advanced Electromagnetics and Electromagnetic Scattering, freely available in pdf on the Course website, 2016.
• C.A. Balanis, Advanced Engineering Electromagnetic, 2nd ed., Wiley, New York, 2012.
• C.A. Balanis, Antenna Theory: Analysis and Design, 4th ed., Wiley, New York, 2016.
• R.C. Booton, Computational Methods for Electromagnetics and Microwaves, Wiley, New York, 1992.
• Complementary material (slides, tutorials, papers) available on the Course website.
• Propaedeutic material: F. Frezza, A Primer on Electromagnetic Fields, Springer, Berlin, 2015.