UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	ELECTRONICS ENGINEERING
SUBJECT	ANTENNAS AND WIRELESS SYSTEMS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50364-Ingegneria elettronica
CODE	20520
SCIENTIFIC SECTOR(S)	ING-INF/02
HEAD PROFESSOR(S)	CINO ALFONSO CARMELO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**CINO ALFONSO CARMELO** Thursday 11:30 13:30 Ufficio del docente (Ed. 9, III Piano) o canale del corso "Campi Elettromagnetici" su Teams

DOCENTE: Prof. ALFONSO CARMELO CINO

PREREQUISITES	Electromagnetic Fields course.
LEARNING OUTCOMES	Knowledge and understanding On completion of this course the student will gain knowledge on the generation and reception of electromagnetic waves for telecommunications. The student, which is supposed to have a previous knowledge of electromagnetics, on course completion will: - have a knowledge of the mechanisms underlying the generation and propagation of electromagnetic waves, taking into account medium properties and atmospheric perturbations; - have a knowledge of most common antenna types used for radio communications and will be able to calculate their radiation characteristics; - be able to dimension a radio link so as to meet design specifications; - have a knowledge of specific antenna types used for indoor wireless systems. To meet this objective, the course includes: traditional lectures; analysis and discussion of specific technical applications. Verification of this objective is based on a discussion of course topics during the oral exam Applying knowledge and understanding Students will be able to: - make use of calculus tools and software to solve problems where electromagnetic waves play a major role; - carry out design tasks for radiating systems, making proper use of modeling methods to find out correct parameters and specifications. To meet this objective, the course includes: exercise classes on modelling and comparison between circuit and electromagnetic approaches; exercise classes on design problems. Verification of this objective is based on the discussion of a design topic during the oral exam. Making judgments The mix of theoretical and experimental knowledge will give the student the ability to understand complex design scenarios. In particular, he will be able to: - apply his knowledge and understanding to pursue the solution of the most common electromagnetic waves communication technical problems; - correctly read a catalog to choose components, equipment and systems, best suited to proposed specifications for free-space and indoor propagation; - correctly understand electromagnetic measurements in order to respect/meet specifications; - consider performance limitations of the various available technologies. To meet this objective, the course includes: systematic comparison of systemic/ circuit and electromagnetic points of view. Verification of this objective is pursued through the oral exam. Communication skills The student will be able to: - acquire a communication skill appropriate to describe problems regarding the generation and propagation of electromagnetic waves; - identify/use physical parameters and terminology specific to applied electromagnetics; - discuss on current topics pertaining to antenna characteristics and radio communication problems. To meet this objective, the course includes: exercise classes and discussions on the adopted design SW. Verification of this objective is pursued through the oral exam. Learning skills The student will be able to: - begin the study of more complex tasks such as the development of ad hoc devices in the context of telecommunication electronics; - be self-sufficient for the search of specific scientific/application literature; - read and understand correctly professional and specialized books. To meet this objective, the course includes: traditional lectures; analysis and discussion of design and multidisciplinary topics. Verification of this objective is pursued through the oral exam.
ASSESSMENT METHODS	Oral Exam Oral exam proceeds with a series of questions which are meant to assess whether the student has acquired the skills and subject knowledge expected from the course; evaluation mark is awarded on a 30-point scale. Questions are intended to verify a) the acquired knowledge on electromagnetic models of antennas and their limitations; b) the ability to apply models in technical applications scenarios; c) the possession of effective communication skills. In more detail, a) Regarding the verification of knowledge, it is required the ability to establish connections between the different course elements (physical theories,

	mathematical models, calculation and design tools, etc.). Minimal marks will be given when ability is mainly restricted to calculation and modeling aspects; higher marks when it includes the design perspective; score indicator range: Excellent 10, Autonomous and effective 8-9, Acceptable 6-7, Fragmentary or partly superficial 4-5, Inadequate 0-3. b) Regarding the verification of the ability to apply models, it will be considered the capacity to account for, to take a critical look at and to modify, the design choices. Minimal marks will be given when ability is mainly restricted to clarification of single points of the analysis/design; higher marks when it encompasses the skill to find new and proper design solutions after a change in the system under study; score indicator range: Excellent 10, Adequate 8-9, Acceptable also if partly driven 6-7, Limited 4-5, Inadequate 0-3. c) Regarding the verification of the communication skills, minimal marks will be given when the student uses a proper technico-scientific language but only at a basic level; higher marks when he is clear and articulate with the specific technical context of applied electromagnetics; score indicator range: Excellent 10, Effective and Well-structured 8-9, Generally satisfactory 6-7, Hesitant and rough 4-5, Inadequate 0-3.
EDUCATIONAL OBJECTIVES	The “Antennas and wireless systems” course is aimed to give the student, with a basic and intuitive approach, a theoretical and design knowledge regarding the more common antennas used in telecommunication applications. Their analysis and design will be set in the perspective of electromagnetic waves classification and properties. Specific attention will be devoted to antennas used for indoor wireless systems.
TEACHING METHODS	Traditional lectures, Exercise classes, Laboratory, Reading and commentary of Scientific Papers, Calculations and computer Simulations.
SUGGESTED BIBLIOGRAPHY	1) Fawwaz T. Ulaby, U. Ravaioli: Fundamentals of Applied Electromagnetics, Global Edition, Pearson (2015) ISBN: 1292082445; 2) John D. Kraus, Antennas, McGraw-Hill, (1988) ISBN 0070354227; 3) Sophocles J. Orfanidis, Electromagnetic Waves and Antennas, libro gratuito in inglese disponibile su (free book available at) www.ece.rutgers.edu/~orfanidi/ewa; 4) Michael B. Steer, Fundamentals of Microwave and RF Design. NC State University (2019), ISBN 9781469656892 , e-book gratuito (free e-book) disponibile su (available on) https://repository.lib.ncsu.edu/handle/1840.20/36776. Per consultazione/approfondimenti (reference books): Ramo-Whinnery-Van Duzer: Fields and Waves in Communication Electronics, Wiley (1994) ISBN: 0471585513 [oppure la traduzione italiana della penultima edizione, Campi e onde nell’elettronica per le comunicazioni. Franco Angeli (1984)]; Maurizio Zoboli, Campi e onde elettromagnetici. Societa' editrice Esculapio (2011) ISBN: 8874884303; C.A. Balanis, Antenna Theory: Analysis and Design, Wiley (2016) ISBN: 1118642066, ma va bene una qualunque edizione (all editions are useful); Dispense e SW libero reperibili in Internet (su indicazione del docente).

SYLLABUS

Hrs	Frontal teaching
4	Electromagnetic wave propagation: review and new concepts.
2	Electromagnetic potentials.
2	Field generated by an Hertzian dipole; radiation resistance, radiation patterns, directivity.
2	Near and far fields produced by localized sources; far field approximations.
4	Wire and loop antennas.
2	Aperture antennas.
2	Reflector antennas.
2	Antenna arrays.
2	Printed antennas.
2	Receiving antennas.
2	Friis formula and the analysis of a radio link.
2	Terrestrial radio propagation.
4	Antennas for indoor wireless systems.

Hrs	Practice
10	Exercise classes devoted to the application in practical cases of the general methods illustrated during lectures. Analysis and design of specific antenna types by means of dedicated SW. In particular, the free 4nec2 program and some free online design/calculation tools will be used.

Hrs	Workshops
6	Realization and measurement of some radio links and comparison with predictions from Friis model.