UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2017/2018
MASTER'S DEGREE (MSC)	ELECTRICAL ENGINEERING
SUBJECT	WIRELESS NETWORKS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20923-Attività formative affini o integrative
CODE	06246
SCIENTIFIC SECTOR(S)	ING-INF/03
HEAD PROFESSOR(S)	TINNIRELLO ILENIA Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	WIRELESS NETWORKS - Corso: INGEGNERIA DELLE TELECOMUNICAZIONI WIRELESS NETWORKS - Corso: TELECOMMUNICATION ENGINEERING
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**TINNIRELLO ILENIA** Monday 9:00 12:00 Ufficio del docente, presso il DEIM, secondo piano.

DOCENTE: Prof.ssa ILENIA TINNIRELLO

PREREQUISITES	The course is self-consistent.However, it is recommended to have some basics of signal theory and probability.
LEARNING OUTCOMES	Knowledge and understanding At the end of the class, the student will be able to understand in depth the problems which characterize the design and the optimization of wireless networks and cellular systems, in various application scenarios (voice and data) and under different propagation conditions (line-of-sight, multipath, etc.). In particular, the student will learn the consolidated and emerging solutions for the management of radio resources and mobility, by starting from the review of the GSM/UMTS standards for cellular systems, and 802.11 standard for WLAN systems. To achieve this goal, the course includes: teacher-led lessons; analysis and discussion of case studies; seminars and guided debates on emerging research topics. Applying knowledge The student will be able to solve some simple design problems for cellular systems based on the utilization of radio propagation models (devised to assess the network coverage) and traffic engineering tools. She/he will be able to design customized protocols and perform context-specific optimizations in various application scenarios. To achieve this goal, the course includes teacher-led lessons and exemplar design solutions, as well as individual homework. Judgements The student will be stimulated to extrapolate the techniques and the algorithms presented in the course from the relevant contexts and technologies in order to apply/adapt these tools to different wireless systems and application scenarios. She/he will also be able to compare alternative architectures and protocol solutions for wireless networks, by performing some performance evaluations based on simplified models or simulation tools. To achieve this goal, the course offers teacher-led lessons and complete examples of system designs, as well as open discussions of case studies and debates on selected research topics. Communication skills The studend will learn the ability to rationally communicate her/his knowledge about the concepts and methods of the discipline, with a good level of clearness, fluency and correct use of technical language. In particular, she/he will be able to justify the design choices and the application of specific tools for solving the proposed analysis or synthesis problems. To achieve this goal, the student can rely on the teacher-led lessons and presentations of case studies. Learning skills The student will be able to read autonomously technical standards and scientific literature about wireless networks, in order to follow the evolutions and trends of wireless technologies and, in particular, to understand the implications of the new physical layers (e.g. full-duplex systems, massive MIMO, etc.) and medium access protocols currently under debate. To achieve this goal, the course presents some teacher-led solutions of specific design problems, technical debates on emerging topics and the relevant literature.
ASSESSMENT METHODS	EXAM ORGANIZATION The examination is based on a mandatory written test and an optional oral exam. The oral exam allows to improve the written test evaluation. To take the oral exam, it is required to have at least a sufficient evaluation of the written test. The grade of the written test is given in the range 0-30/30. The minimum grade to pass the test is 18/30. The oral test is evaluated in the range of 0-3/30 to be added to the grade of the written test. The final grade is given by the written test grade (in case the student does not take the oral exam) or by the sum of the written test and oral exam grades. DESCRIPTION OF THE TESTS The written test includes two parts: a first part focused on the design of simple wireless systems, with some problems about the planning of cellular networks based on radio propagation models and traffic engineering tools; a second part with open and semi-structured questions about all the course contents. The written test lasts 3 hours. The test is devised to evaluate: -The knowledge and understanding levels of radio propagation models and tele-traffic tools, with specific applications to the design of cellular systems; -The capability of applying the acquired knowledge to solve autonomously

	design problems and protocol optimizations; -The ability to communicate knowledge, analyses and conclusions, and justify the design choices. The oral exam lasts about 30 minutes. It is based on the autonomous elaboration of an advanced/research topic (typically about emerging wireless technologies) selected by the student, which is organized in a power-point presentation. The exam allows to assess: -The capability of reading and understanding the research literature and the technology standards related to the course topics; -The ability to communicate knowledge, analyses and conclusions, with a good level of clearness, fluency and correct use of language; -The ability of reinterpretation of the concepts and interdisciplinary connections, showing evidence for autonomously undertaking further studies or professional activity. LEARNING OUTCOMES In order to provide the overall evaluation, we will estimate the results achieved in the following course objectives. Knowledge and understanding: Evaluation of knowledge, understanding and integration of principles, concepts, methods and techniques of the discipline. Applying knowledge: Evaluation of capabilities in applying theoretical and technical knowledge for tackling and solving problems; evaluation of the autonomy level and originality of proposed solutions. Making judgements: Evaluation of logical, analytical and critical abilities for reaching appropriate judgments and decisions, based on available information and data. Communication skills and learning skills: Evaluation of the ability to communicate knowledge, analysis and conclusions, with a good level of clearness, fluency and correct use of language. Evaluation of the capability of reinterpretation and interdisciplinary connection, showing evidence for autonomously undertaking further studies or professional activity. GRADES 30-30 and laude: Excellent. Full knowledge and understanding of concepts and methods of the discipline, excellent analytical skills even in solving original problems; excellent communication and learning skills. 27-29: Very good. Very good knowledge and understanding of concepts and methods of the discipline; very good communication skills; very good capability of concepts and methods applications. 24-26: Good. Good knowledge of main concepts and methods of the discipline; discrete communication skills; limited autonomy for applying concepts and methods for solving original problems. 21-23: Satisfying. Partial knowledge of main concepts and methods of the discipline; satisfying communication skills; scarce judgment autonomy. 18-20: Acceptable: Minimal knowledge of concepts and methods of the discipline; minimal communication skills; very poor or null judgement autonomy. Non acceptable: Insufficient knowledge and understanding of concepts and methods of the discipline.
EDUCATIONAL OBJECTIVES	This course provides an overview of wireless networks, based on the presentation of the main technical features characterizing these networks (wireless propagation, interference, mobility), the main approaches and design principles, as well as some specific examples of wide-spread technologies for both cellular systems and wireless local area networks. A first educational objective is understanding radio propagation and traffic generation phenomena, in order to identify the system requirements to be used for network design. A second educational objective, is understanding the main features and technical aspects of public cellular systems, with special attention to GSM/GPRS and 802.11 networks. Finally, a third educational objective is providing methods and approaches for evaluating complex radio systems, by characterizing the interactions between applications, physical layers, MAC layers, in order to be able to design/adapt existing protocols to the emerging network scenarios.
TEACHING METHODS	Teacher-led lessons and design examples; guided debates on emerging research topics.
SUGGESTED BIBLIOGRAPHY	- Shankar, “Introduction to Wireless Systems”, Wiley, 2001 - Eberspacher, Vogel, Bettstetter, “GSM switching, services & protocols”, Wiley, 2001 - Matthew Gast, “802.11 Wireless Networks: The Definitive Guide”, O'Reilly - Peter McGuiggan, “GPRS in Practice – a companion to the specifications” Articoli selezionati da letteratura scientifica sui temi trattati Lucidi del corso (disponibili sul sito Internet del docente)

SYLLABUS

Hrs	Frontal teaching
2	Radio channel characterization. Propagation and fading models.
2	Network planning concepts: frequency reuse and clustering.
4	Planning of simple cellular systems based on radio converage requirements: outage probability.
4	Planning of simple cellular systems based on tele-traffic engineering: Erlang B formula and its applications.
2	GSM General Architecture.
4	GSM Radio Interface: logical and physical channels, synchronization algorithms, power control, handover and re-selection mechanisms.
4	Mobility management in GMS: location registration and update, authentication and cryptography tools, international roaming, additional services (e.g. number portability).
2	Architectures for wireless local area networks: infrastructure and ad-hoc modes; addressing solutions.
2	Physical layers for WLANs: 802.11a/b/g/n standards.
6	Medium access layer for WLANs: DCF and PCF protocols. Performance evaluation of DCF.
4	Extentions of Medium Access Control protocols for WLANs and optimizations: quality of service (QoS) support, fragmentation, use of directional antennas, multi-hop topologies.
4	GPRS architecture and protocols: comparison and updates on the GMS architecture. Mobility and session management in GPRS data sessions: routing areas, GPRS attach and PDP context. GPRS radio interface: MAC/RLC layers, packet data channels.
4	Third generation cellular systems: UMTS. UMTS Radio Interface: code division multiple access; orthogonal and pseudo-orthogonal codes. Logical, transport and physical channels. Examples of network access procedures.
4	Introduction to 3G long term evolution: LTE.

Hrs	Practice
4	Examples of cellular system designs.
4	Examples of applications of tele-traffic tools to cellular system design.