COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Advanced Wireless Communications

2. Date despre disciplină

2.1 Course name (ro) (en)				Comunicații wireless - Arhitectură și securitate Wireless Communications: Architecture and Security			
2.2 Course Lecturer				Conf. Dr. Alexandru Vulpe			
2.3 Instructor for practical activities				Prof. Dr. Ing. Alexandru Martian			
2.4 Year of studies	1	2.5 Semester	I	2.6. Evaluation type	V	2.7 Course regime	Ob
2.8 Course type		DA	2.9 Course code	UPB.04.M1.O.21-04		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	2.5	Out of which: 3.2 course	1.50	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	35.00	Out of which: 3.5 course	21	3.6 seminary/laboratory	14
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					36
Tutoring					0
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	40.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	N/A

4.2 Results of learning	general knowledge of signals and systems, modulation, data transmissions, programming, fundamental aspects of mobile communications

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	The lectures will take place in a room equipped with a video projector and computer
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room with specific equipment, which must include: computer, mouse, keyboard, specific software

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

The objective of the course is to familiarize with wireless networks, especially mobile communication systems and the ones standardized by 3GPP. In the second part, security concepts are treated with emphasis on wireless networks, as well as the main methods of securing them. Lab applications aim to train students to link mobile communications with security concepts. Concrete applications will be made in which students will use different technologies and tools for the security of wireless networks

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	Demonstrates basic/advanced knowledge of wireless communications. Applies knowledge in the field of wireless communications in practice Argues and analyzes coherently and correctly the context of application of the basic knowledge of wireless communications, using their key concepts and the specific methodology. Oral and written communication in a foreign language (English): demonstrates understanding of wireless communications vocabulary in a foreign language.
Transversal (General) Competences	Works in a team and communicates effectively, coordinating his/her efforts with others to solve problem situations of medium complexity. Autonomy and critical thinking: the ability to think in scientific terms, to search and analyze data independently, and to draw and present conclusions / identify solutions. Ability to analyze and synthesize: presents the acquired knowledge in a synthetic way, as a result of a systematic analysis process. Respect the principles of academic ethics: in the documentation activity, correctly cite the bibliographic sources used.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* • Lists the most important milestones that marked the development of wireless communications. • Defines specific notions of wireless communications from the point of view of their architecture and security.â • Describes concepts and processes that occur in wireless communications.
Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* • Selects and groups relevant information in a given context. • Uses specific principles in order to design and implement wireless communication networks. • Works productively in a team. • Interprets causal relationships appropriately. • Analyzes and compares wireless communication network implementation techniques. • Identifies solutions and develops resolution/project plans. • Argues the identified solutions/workarounds.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Selects appropriate bibliographic sources and analyzes them. • Respects the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrates responsiveness to new learning contexts. • Demonstrates collaboration with other colleagues and teaching staff in carrying out didactic activities • Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved • Demonstrates social responsibility through active involvement in student social life/involvement in academic community events • Realizes the value of his/her contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility). • Applies principles of professional ethics/deontology in the analysis of the technological impact of the solutions proposed in wireless communications. • Analyzes and capitalizes on business/entrepreneurial development opportunities in wireless communications. • Demonstrates real-life situation management skills (time management, collaboration vs. conflict).

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Starting from the analysis of the students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct exploration and indirect way of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving.
The presentation of the course lessons is combined, being based both on the use of the video projector (for communicating the theoretical foundations, for demonstrations, descriptions of schemes, etc.), but also on the use of the blackboard (for examples, justifications or checks, with the direct participation of students)
The discipline covers information and practical activities designed to support students in their learning efforts and the development of optimal collaborative and communication relationships in a climate conducive to discovery learning.
The dialogue with the students is open, with questions and answers whenever necessary.
The materials used are: course notes, scientific papers, technical notes written by different actors in the field of mobile cellular networks (operators, equipment manufacturers, professional associations)

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	4G digital radio communications - High data rates in mobile communication systems - LTE principles - LTE channels - LTE-Advanced	6
2	Insights into 5G principles and networks - Technologies - Use cases - 5G NO - 3GPP Rel. 15 and later	6
3	General security concepts for wireless networks. Standards and applications of wireless networks: - Wi-Fi - Cellular - Satellite - Ad hoc - Sensors	1
4	Vulnerabilities in wireless networks: - WEP, - Encryption algorithms, - Key management, - User behavior, - Theft of devices	3
5	Security issues in wireless networks. - ad hoc and infrastructure networks - the footprint of wireless networks - passive attacks - authentication and authorization - active attacks and DoS	5
	Total:	21

Bibliography:
1) I.Marghescu, Şt.Nicolaescu, N. Coţanis, "Comunicaţii mobile terestre", Editura Tehnică, 1999.
2) Fratu, S. Halunga, "UMTS – O nouă generaţie în comunicaţiile mobile digitale (Aspecte generale.Interfaţa radio)", Editura Electronica 2000, Bucureşti, 2003, ISBN 973-99878-5-0
3) Vulpe A., "Contribuții la optimizarea sistemelor de comunicații mobile de generația a patra", PhD thesis, București, 2014
4) E. Dahlman, St. Parkvall, J. Sköld, „4G LTE/LTE-Advanced for Mobile Broadband", Academic Press,Oxford, UK, 2011, ISBN 978-0-12-385489-6
5) S.K.PARMAR, Computer, Internet and Network Systems Security, 2015
6) S. Sicari, A. Rizzardi L.A. Grieco, A. Coen-Porisini, "Security and Privacy in IoT: the road ahead",Computer Networks, Vol 76, 2015, pp. 146-164, ISSN 1389-1286,https://doi.org/10.1016/j.comnet.2014.11.008.
7) Lecture notes in electronic format.

LABORATORY

Crt. no.	Content	No. hours
1	Dynamic channel allocation in a mobile communication system. Performance evaluation of some algorithms.	2
2	Encryption algorithms	2
3	Authentication and Authorization	2
4	DoS attacks	2
5	Defining the user profile and USIMs in an LTE network. SIM card security.	2
6	Study of message flow between a mobile terminal and the LTE network and identification of vulnerabilities	2
7	Final evaluation	2
	Total:	14

Bibliography:
Laboratory platforms in electronic format

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	- knowledge of fundamental theoretical notions; - knowledge of how to apply the theory to specific problems; - differential analysis of theoretical techniques and methods.	Exam held at the end of the semester.	50%
11.5 Seminary/laboratory/project	- appreciation for the understanding of some fundamental notions and concepts within data communication systems and their security;.	Laboratory test	50%
11.6 Passing conditions			

Obtaining 50% of the total score. Obtaining 50% of the score related to the activity during the semester

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

The discipline is designed to directly address the needs and expectations of employers in the wireless communications sector, who seek graduates with solid and up-to-date knowledge of wireless network architectures and their security. Regular consultations with industry representatives and professional associations have ensured that the topics covered are relevant to the current and future labor market requirements. Students acquire an in-depth understanding of 3GPP standards and their evolution, essential for the development and implementation of mobile communication systems, as well as practical skills in the assessment and implementation of security measures in wireless networks, an area of increased interest to employers due to the proliferation of cyber threats.
The course curriculum is constantly updated to reflect the latest advances and trends in wireless communications and network security. The latest research and technological innovations from the research projects in which the holders of the discipline participate are integrated in the didactic materials and laboratory activities. A critical understanding of the impact of new technologies, such as 5G networks and emerging technologies, on network architectures and security is promoted.
The teaching content and methods are designed in accordance with the best practices of higher education institutions in the European Higher Education Area. A competency-based approach is taken that encourages active and applied learning through laboratory projects and case studies that simulate real scenarios encountered in industry. Academic mobility and international collaborations are also promoted, through the involvement in joint research projects and exchange of experience with other EHEA universities.

Date	Course lecturer	Instructor(s) for practical activities
03.10.2024	Conf. Dr. Alexandru Vulpe	Prof. Dr. Ing. Alexandru Marțian

Date of department approval	Head of department
27.10.2024	Conf. Dr. Serban Georgica Obreja

Date of approval in the Faculty Council	Dean
25.10.2024	Prof. Dr. Mihnea Udrea

Universitatea Națională de Știință și Tehnologie Politehnica București

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