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	Services and Network Management

2. Date despre disciplină

2.1 Course name (ro) (en)				Tehnologii de acces şi transport			
2.2 Course Lecturer				S.l./Lect. Dr. Adrian Florin Paun			
2.3 Instructor for practical activities				S.l./Lect. Dr. Adrian Florin Paun			
2.4 Year of studies	2	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		DA	2.9 Course code	UPB.04.M3.O.11-33		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42.00	Out of which: 3.5 course	28	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.					54
Tutoring					0
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Data Communications Advanced Wireless Communications Communications Networks Theory and Information Transmission
4.2 Results of learning	General knowledge related to digital signal processing, communications of data, techniques of modulation and coding of signals used in telecommunications.

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

5.1 Course	The course will take place in a room equipped with video projector and computer. materials for the course include: bibliography books, course notes and course presentations, documents of proposed and solved problems as well as other materials. Course notes will be available in Moodle.
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room with specific equipment, which must include PCs on which the Python environment and Network Simulator 3 should be installed. The laboratory sessions are dedicated theoretical and experimental analysis of various data access and multiplexing techniques. The lab guide and simulation files are available on the platform Moodle. Attendance at the laboratories is mandatory (according to the internal regulations university in UNSTPB).

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)*

This discipline is dedicated to the assimilation of theoretical knowledge related to multiple access techniques with centralized or distributed control (FDMA/TDMA/CDMA/OFDMA/ SC-FDMA/IDMA/SCMA/ RPMA), and to multiplexing techniques (TDM, FDM, DWDM) developed for fixed and mobile telecommunications networks. The performance criteria regarding the efficient use of resources (power, frequency band, etc.) are discussed, but also those related to ensuring the quality of services (delay, jitter, blocking probability, etc.). The fixed access technologies (xDSL, DOCSIS, xPON) and mobile access technologies, both those of the 1G-4G generation and those with distributed control (variants of Aloha, CSMA/CD, CSMA/CA), are analyzed to evaluate the performance in different typical scenarios. The main digital broadcasting technologies (DAB, DVB-T, DVB-H) and the main transport technologies for current networks (SDH, ATM, MPLS) are also presented.

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 that he has basic/advanced knowledge in the field of access networks and data transport It correlates the knowledge specific to the field of multiple access and multiplexing with those of to the other disciplines belonging to the area of electronic engineering, telecommunications and information technologies. Identify and apply in practice the knowledge specific to the field of multiple access and transport networks. Apply standardized methods and tools, specific to the field, for the achievement the process of evaluating and diagnosing a situation, depending on the problems identified/reported, and identify solutions. Argue and analyze coherently and correctly the context of application of the knowledge of basis of the field, using key concepts of the discipline and specific methodology. Oral and written communication in Romanian: uses specific scientific vocabulary field, in order to communicate effectively, in writing and orally. Oral and written communication in a foreign language (English): demonstrates understanding the vocabulary related to the field, in a foreign language.
Transversal (General) Competences	Works in a team and communicates effectively, coordinating efforts with others to solving problem situations of medium complexity. Autonomy and critical thinking: the ability to think in scientific terms, to search and analyze data independently, and draw and present conclusions /identify solutions. Ability to analyze and synthesize: presents the acquired knowledge in a synthetic way, ca following a systematic analysis process. Respect the principles of academic ethics: cite correctly in the documentation activity the bibliographic sources used. Put into practice elements of emotional intelligence in socio-emotional management appropriate to real-life/academic/professional situations, demonstrating mastery of self and objectivity in decision-making or in stressful situations.

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.* It lists the most important stages that marked the development of the field. Defines domain-specific notions. Describes/classifies notions/processes/phenomena/structures. It highlights consequences and relationships.
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).* Select and group relevant information in a given context. Work productively in a team. Elaborate a scientific text. Experimentally verify identified solutions. Solve practical applications. Interpret causal relationships appropriately. Identifies solutions and develops resolution/project plans. Formulate conclusions to the experiments carried out. Argue the identified solutions/workarounds.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Select appropriate bibliographic sources and analyze them. Respect 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 teaching activities. Demonstrates autonomy in organizing the learning situation/context or problem situation solved. Demonstrates social responsibility through active involvement in student social life/involvement in events in the academic community. Promote/contribute new solutions related to the field of expertise to improve the quality of social life. Realizes the value of its engineering contribution to identifying solutions viable/sustainable to solve problems in social and economic life (responsibility social). Apply principles of professional ethics/deontology in analyzing the technological impact of solutions proposed in the specialized field on the environment. Analyze and capitalize on business/entrepreneurial development opportunities in the field of specialty. 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 students' learning characteristics and their specific needs, the process of teaching will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, activities practice and problem solving.

Lectures will be used in the teaching activity, with Power Point presentations or various videos that will be made available to students. Each course will begin with the recapitulation of the chapters already covered, with emphasis on the notions covered in the last course. National University of Science and Technology Politehnica Bucharest Faculty of Electronics, Telecommunications and Information Technology Presentations use images and diagrams so that the information presented is easy to understand and assimilate.
This discipline covers information and practical activities designed to support students in their endeavors to learning and the development of optimal collaboration and communication relationships in a climate conducive to learning by discovery.
It will be considered to practice the skills of active listening and assertive communication, as well as a feedback construction mechanisms, as ways of behavioral regulation in various situations and adapting the pedagogical approach to the students' learning needs.
Teamwork skills will be practiced to solve different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Brief history. Internet access technologies. Wireless access technologies: brief description. Fixed access networks. Examples. RAT evolution towards and beyond 4G.	2
2	Characterization of the communication channel, channel capacity, digital modulation techniques: BPSK, QPSK, QAM, OFDM.	4
3	Multiple access techniques for traditional systems. Characteristics, parameters and capacity of systems: FDMA, TDMA, CDMA, IDMA.	2
4	Multiple access techniques for systems with packet data transmission (Packet Radio-PR): ALOHA, CSMA, SDMA	2
5	Multiplexing techniques in time, frequency, wavelength. Transport technologies PCM, SDH, WDM, ATM, MPLS/IP, GMPLS.	2
6	Fixed access technologies: twisted pair, xDSL, fiber optic, xPON, coaxial cable, DOCSIS.	2
7	Local radio access networks (WLAN): applications, standards, defining parameters, examples, comparisons, security aspects of WLAN networks.	2
8	WMAN Metropolitan Access Radio Networks: General Aspects; particularities. WiMAX technology: standards, architecture; applications.	2
9	WPAN Personal Radio Networks: General Aspects; examples: Bluetooth, ZigBee. Other technologies for wireless sensor networks (USB wireless, Wibree, Z-Wave).	2
10	Rețele radio de acces de arie mare: UMTS, LTE.	4
11	Broadcast networks: general aspects, particularities. DAB technology. DVB technology (applications, standards, particularities).	2
	Total:	28

Bibliography:
[1] Course notes - digital format, Moodle
[2] R. Prasad, L. Munoz, "WLANs and WPANs towards 4G wireless", Artech House, Boston, USA, 2003, ISBN 1-58053-090-7
[3] S. Halunga, O. Fratu "Data transmissions and multiple access techniques" (2009) Electronica Publishing House 2000, Bucharest, 290 pages, ISBN 978-973-7860-17-0
[4] T.S. Rappaport, Wireless Communications: Principles and Practice (2nd Ed), Prentice Hall, 2002
[5] H. LABIOD, WiFi, Bluetooth, ZigBee and WiMax, Springer, 2007
[6] Luc De Ghein. MPLS Fundamentals. Cisco Press, 2006.
[7] M. Gast, 802.11 Wireless Networks, O'Reilly, 2005.

LABORATORY

Crt. no.	Content	No. hours
1	Channel capacity	2
2	Simulation of multiple access techniques with centralized and distributed control	2
3	Wi-Fi network performance study	2
4	The study of the performance of LTE networks according to the number of users, the model of the communication channel.	2
5	The study of the handover procedure in an LTE network	2
6	Analysis and design of DWDM optical transport networks	2
7	Studiul tehnologiilor DVB-T, DVB-H	2
	Total:	14

Bibliography:
[1] Laboratory notes - digital format, Moodle
[2] NS3 tutorials in digital format: www.nsnam.org/documentation
[3] T.S. Rappaport, Wireless Communications: Principles and Practice (2nd ed.), Prentice Hall, 2002
[4] H. LABIOD, WiFi, Bluetooth, ZigBee and WiMax, Springer, 2007

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;	Mid-semester test	20%
	- description and theoretical analysis of advanced data transmission techniques and systems; - differentiated analysis of the performance of techniques and theoretical methods;	Final Exam	40%

11.5 Seminary/laboratory/project	writing programs in Python, C++ (NS3) for simulating the described scenarios and analyzing them	Worksheets	20%
	- the ability to apply theory to solving problems related to access technologies, in a specific practical context. - writing an original program in Python, C++ (NS3) for simulating a specific aspect of an indicated technology and analyzing and interpreting the results	Final laboratory report	20%
11.6 Passing conditions			
Obtaining 50% of the total score			

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)

In the current data communication networks, specific multiple access and transport technologies are used, which combine advanced signal processing methods with multiple access and multiplexing techniques to optimize the efficiency of using the telecommunications channel
Through specific learning activities, students develop skills to solve various engineering problems and propose solutions to improve the performance of advanced access or transport communications networks.
The course has a similar content to other courses within similar master's programs organized at
The University of Oulu, Finland, but also other universities in the European space.
The course curriculum responds to the current requirements of organization and development, subscribed to the European evolution and world in the field of information and communication technology (ICT).

Through laboratory, project and course, engineering management skills are developed, considering theoretical and practical situations with which
students can face each other in real life, to increase their contribution to the improvement of the socio-economic environment.

Date	Course lecturer	Instructor(s) for practical activities
14.10.2024	S.l./Lect. Dr. Adrian Florin Paun	S.l./Lect. Dr. Adrian Florin Paun

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

Date of approval in the Faculty Council	Dean
01.11.2024	Prof. Dr. Mihnea Udrea