Universitatea Națională de Știință și Tehnologie Politehnica București

Facultatea de Electronică, Telecomunicații și

Tehnologia Informației

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 Software Technologies for Communications

2. Date despre disciplină

2.1 Course name (ro) (en)				Simularea rețelelor de comunicații			
2.2 Course Lecturer							
2.3 Instructor for practical activities				Professor Roxana Zoican			
2.4 Year of studies	2	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.09-05		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	2	Out of which: 3.2 course	0.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	28.00	Out of which: 3.5 course	0	3.6 seminary/laboratory	28
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.					42
Tutoring					0
Examinations					5
Other activities (if any):					-2.5

3.7 Total hours of individual study	47.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion of the following disciplines: Networks and services, Mobile communication networks, Arrchitectures and communications protocols, Architectures for networks and services

4.2 Results of learning	Knowledge accumulation regarding : general knowledge of communication networks design and especially of mobile communication networks, of operation with communication network simulators (OPNET, GNS3, OMNET++), programming

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

5.1 Course	It is not necessary
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room with specific equipment, which must include: computers and installed software (OPNET, OMNET++, Matlab, Sensoria, NS2, Qualnet, Wireless Sensor Network Localization Simulator)

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 course is studied within the field of Electronic Engineering, Telecommunications and Information Technologies / the Advanced Software Technologies for Communications master's program and aims to familiarize students with the main approaches, models and explanatory theories of the field, used in the telecommunications networks design and simulation, with relevance for stimulating the students learning process.
The Telecommunications Network Simulation discipline allows graduates of the Master's program in Advanced Software Technologies for Communications to participate in the design, implementation and development of the existing communications networks and of the routing and location determination protocols, ensuring they are competent in:
• management of radio resources and mobility in various wireless networks
• performance and routing protocols evaluation and location determination
• planning and modeling of communication 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	•Description of the main quantitative methods for evaluating the performance of telecommunications networks. •Description of assumptions, simplifications and common generalizations made in the modeling of telecommunications networks. •Implementation, verification and validation of the telecommunications networks simulation models. •Designing and experimenting with simulation models of different telecommunications networks, as well as evaluating results obtained through simulation. •Explanation of the design solutions selected in the use of protocols, algorithms and existing network architectures, to ensure the required performances. •Coherent and correct argumentation and analysis of the basic knowledge of the field application context, using key concepts of the discipline and specific methodology. •Oral and written communication in Romanian: uses the scientific vocabulary specific to the field, in order to communicate effectively, in writing and orally. •Oral and written communication in a foreign language (English): demonstrates understanding of 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 solve problem situations of medium complexity •Autonomy and critical thinking: the ability to think in scientific terms, 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, as a result of a process of systematic analysis. •Respect the principles of academic ethics: correctly cite the bibliographic sources used in the documentation activity. •Integrating elements of emotional intelligence into practice in the appropriate social-emotional management of real-life/academic/professional situations, demonstrating self-control and objectivity in decision-making or 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.* •The ability to use different simulation programs and to select the optimal simulation model depending on the characteristics of the telecommunications network to be implemented and the imposed requirements. •Creating the necessary skills to select the appropriate protocols and algorithms for a particular network system. •The ability to analyze different types of networks in order to achieve the required performances. •The ability to perform statistical analysis on experimental or simulation data and draw correct conclusions about the performance of the studied system. •The ability to design a telecommunications network for a specific scenario and specified performance objectives. •The ability to analyze and compare different network protocols, algorithms and architectures, as well as their advantages and disadvantages.
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. •Reasonably uses specific principles in order to solve various problems with the help of a program. •Can communicate, motivate and think creatively regarding the specific problems and principles underlying the design of telecommunications networks and their implementation method, using simulation programs. •Work productively in a team, being able to design and experiment, with appropriate simulation models, different telecommunications networks, as well as evaluate the results obtained through simulation. •Elaborate a scientific text. •Experimentally verifies the solutions identified in the design of a certain network and in the use of the existing protocols, algorithms and network architectures, to ensure the required performances. •Solve practical applications, having the necessary knowledge to design a minimal telecommunications network. •Adequately interpret causal relationships. •Analyzes and compares various ways of solving a problem •Identifies solutions and develops resolution plans. •Formulates conclusions to the solved problems. •Argues the identified solutions and ways of solving them.

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 the situation of problems to be solved. •Demonstrates social responsibility through active involvement in student social life/involvement in academic community events •Promotes/contributes through new solutions related to the specialized field to improve the quality of social life. •Realizes the value of his contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility). •Apply principles of professional ethics/deontology in the analysis of the technological impact of the proposed solutions in the specialized field on the environment. •Analyzes and capitalizes on business/entrepreneurial development opportunities in the specialized field. •Demonstrates real-life situation management skills (collaborative vs. conflict time management).

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 teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilities of direct and indirect exploration of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving.
This discipline covers information and practical activities designed to support students in their learning efforts and the development of optimal collaborative and communicative relationships in a climate conducive to discovery learning. It will be considered the practice of active listening and assertive communication skills, as well as feedback construction mechanisms, as ways of regulating behavior 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

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Evaluation of Handover Performances in LTE Networks for Different Scenarios	4
2	Study of Different ZigBee Network Topologies for Wireless Sensor Networks	4
3	Analysis of a Planning Method (Round Robin / Maximum Throughput) of Packets on Downlink in LTE networks	4
4	Configuring Routing Areas and Analyzing a Link Failure in IP Networks that Use the OSPF Protocol	3
5	Comparison of WSN Performances for Star, Tree and Mesh Topologies	3
6	Modeling a ZigBee Routing Scheme for Slotted and unslotted CSMA / CA	4

7	Analysis of Routing Protocols (DSR, DSDV and AODV) Used in Surveillance Missions of WSN Networks Based on the Zigbee Protocol	3
8	MPLS Protocol Performances Evaluation	3
	Total:	28

Bibliography:

1.https://curs.upb.ro/2021/course/view.php?id=9227
2.Anil Kumar Rangisetti, Advanced Network Simulations Simplified: Practical guide for wired, Wi-Fi (802.11n/ac/ax), and LTE networks using ns-3, Ed.Packt Publishing, 2023
3.H.Z.Ceballos, J.E.P. Amaris, H.J.Jimenez, D.A.R.Rincon, O.A.Rojas, J.E.O. Trivino, Wireless Network Simulation, Ed. Apress, 2021
4.A.Virdis, M. Kirsche, Recent Advances in Network Simulation, Ed. Springer, 2020
5.A.Yarali, Wireless Sensor Networks. Technology and Applications, Ed. Nova, 2020
6.D.N.Le, A.K. Pandey, T.M.Sairam, P.R.Rathore, J.M. Chatterjee, Network Modeling, Simulation and Analysis in Matlab, Ed. Wiley-Scrivener, 2019
7.M.Rupp, S.Schwarz, M.Taranetz, The Vienna LTE-Advanced Simulators, Ed.Springer, 2016
8.Juha Korhonen, Introduction to 4G Mobile Communications, Ed. John Wiley and Sons, 2014
9.Manual NS-3 https://www.nsnam.org/docs/release/3.13/manual/ns-3-manual.pdf
10.Simulator LTE-sim https://telematics.poliba.it/index.php?option=com_content&view=article&id=28&Itemid=203&lang=en
11.Manual OMNET++ https://doc.omnetpp.org/omnetpp/manual/
12.Manual Simulink, https://www.mathworks.com/help/simulink/

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course			
11.5 Seminary/laboratory/project	the ability to synthesize and analyze the subject addressed	Written and practice test	20%
	the ability to argue, based on the practical applications, of the presented theoretical models	Written and practice test	30%
	the ability to use telecommunications networks simulation programs (OPNET, OMNET++, Matlab, Sensoria, NS2, GNS3, Qualnet, Wireless Sensor Network Localization Simulator)	Written and practice test	50%
11.6 Passing conditions			
•fulfilling the obligations characteristic of laboratory activities (participating in the planned works, making reports); •obtaining the minimum score of 50% both after completing the evaluations at the laboratory and at the project			

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)

Through the activities carried out, students develop skills to offer solutions to problems and to propose ideas to improve the existing situation in the field of Electronic Engineering, Telecommunications and Information Technologies, the industrial branch Networks and telecommunications software.
•In the development of the content of the discipline, knowledge described by specialized literature and own published and presented research were taken into account.
•The course has a similar content to the courses held by the National University of Science and Technology POLITEHNICA Bucharest.
It is intended to develop the graduate's skills to manage practical situations that he may face in real life in order to increase his contribution to the improvement of the socio-economic environment

Date	Course lecturer	Instructor(s) for practical activities
09.09.2024		Prof. Dr. Roxana Zoican

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