Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti
Facultatea de Electronică, Telecomunicaţii şi
Tehnologia Informaţiei

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	Bachelor/Undergraduate
1.6 Programme of studies	Technologies and Telecommunications Systems

2. Date despre disciplină

2.1 Course name (ro) (en)				Ingineria traficului Traffic Engineering			
2.2 Course Lecturer				Prof. Dr. Grazziela Sevastita Niculescu			
2.3 Instructor for practical activities				Prof. Dr. Grazziela Sevastita Niculescu			
2.4 Year of studies	4	2.5 Semester	II	2.6. Evaluation type	V	2.7 Course regime	Op
2.8 Course type		S	2.9 Course code	04.S.08.A.225		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.					30
Tutoring					0
Examinations					3
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	It's not necessary
4.2 Results of learning	It's not necessary

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.
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room equipped with a video projector and computers.

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 studied within the specialization "Telecommunication networks and software" and aims to familiarize students with the main approaches, models and explanatory theories of traffic-generating sources, traffic switching in communication nodes, its transfer throughout the networks on the optimal routes between sources and destinations and the planning of the telecommunications network in accordance with international QoS recommendations.

All of these contribute to providing students with an overview of the methodological and procedural benchmarks related to the field of telecommunications traffic engineering.

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 knowledge of networks and telecommunications traffic Correlates theoretical and practical knowledge Apply knowledge in practice Apply methods and tools specific to the field, to carry out the evaluation and diagnosis process of a situation, depending on the identified problems and identify solutions to solve them. It argues and analyzes coherently and correctly the context of application of the basic knowledge of the field, using key concepts of traffic engineering and the specific methodology. Oral and written communication in Romanian and English: uses the scientific vocabulary specific to the field, in order to communicate effectively, in writing and orally, and demonstrates understanding of the vocabulary related to the fieldses the scientific vocabulary specific to the field, in order to communicate effectively, in writing and orally, and demonstrates understanding of the vocabulary related to the field
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 and 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. Puts elements of emotional intelligence into practice in the appropriate social-emotional management of 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.* Know the most important stages that marked the development of the field. Correctly defines domain-specific notions. Describes and classifies domain-specific processes and structures It highlights interaction relationships of the components and consequences of some malfunctions
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 improve the processing performance of the traffic in communication networks. **Elaborate** a scientific text. **Verify** identified solutions experimentally and through analytical modeling. **Solve** practical applications. Adequately **interpret** causal relationships. **Analyze and compare** different network topologies and routing algorithms **Formulates** conclusions based on the analyzes carried out
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 problem situation to be solved **Demonstrates** social responsibility through active involvement in student social life/involvement in academic community events **Promotes** 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.

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, facilitated by exploration direct and indirect of reality (experiment, demonstration, modeling), but also on action-based methods, such as exercise and problem solving.

In the teaching activity, lectures will be used, based on some Power Point presentations that will be made available to the students. Each course will begin with the recapitulation of the notions presented in the previous lectures and which allow the development of the issues of the current course.

Presentations use images and diagrams so that the information presented is easy to understand and assimilate.

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

COURSE		
Chapter	**Content**	**No. hours**
1	Analytical tools for modeling and analysis – specifying randomness in communication networks, defining voice and data traffic, the role of traffic engineering, generalities about variables and random processes, Markov chains and birth and death processes	4
2	Modeling of serving systems – systems with exponential arrivals and servings, with finite and infinite queues served ordered, priority or differentiated	12
3	Open networks with deterministic routing composed of lossy or lossless systems	6
4	Networks with M/M/1 (lossless) systems with probabilistic routing with or without return paths	3
5	Traffic planning in communication networks - establishing traffic volumes through measurements in existing networks, the traffic distribution matrix between communication nodes, determining new matrices for various network extension situations	3
	Total:	28

Bibliography:

Lucian Ioan, Grazziela Niculescu – Calitatea serviciilor de telecomunicaţii, Ed. MatrixRom, 2013
Alexandru Rusu, Marius Vochin, Lucian Ioan – Switching systems in telecommunication networks, Ed. Politehnica 2019
Marius Vochin, Alexandru Rusu, Grazziela Niculescu – Routing in telecommunication networks, Ed. Politehnica 2019
Lucian Ioan, Marius Vochin, Grazziela Niculescu – Transmission, switching and routing in communication networks, Ed. Politehnica 2021

LABORATORY		
Crt. no.	**Content**	**No. hours**

1	M x N connection networks with queues on inputs – evaluation of transit time by modeling for different values of offered traffic	3
2	Lossy systems – assessment of involved traffic volumes, serving group with primary overflow and optimal planning of a hierarchical transport network	3
3	Queuing traffic processing systems – performance analysis and optimal sizing for various QoS constraints (losses, transit time, queue size)	3
4	Open networks with M/M/1 systems with return routes (Jackson) – evaluation of performance indicators for a topology imposed on variations of ingress traffic and return paths	3
5	Knowledge assessment colloquium	2
	Total:	14

Bibliography:

Lucian Ioan, Grazziela Niculescu – Calitatea serviciilor de telecomunicaţii, Ed. MatrixRom, 2013
Alexandru Rusu, Marius Vochin, Lucian Ioan – Switching systems in telecommunication networks, Ed. Politehnica 2019
Marius Vochin, Alexandru Rusu, Grazziela Niculescu – Routing in telecommunication networks, Ed. Politehnica 2019
Lucian Ioan, Marius Vochin, Grazziela Niculescu – Transmission, switching and routing in communication networks, Ed. Politehnica 2021

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 and how to apply them to solve specific problems	Final Exam	60 %
11.5 Seminary/laboratory/project	Evaluation of performance indicators for queuing systems and networks	Final colloquium	40 %
11.6 Passing conditions			
The study regulations are applicable in this sense, namely: obtaining 50% of the total score related to the final verifications			

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 propose ideas to improve the situation in the field of implementation and exploitation of telecommunications systems and networks.

Date Course lecturer Instructor(s) for practical activities

Universitatea Națională de Știință și Tehnologie Politehnica București

Facultatea de Electronică, Telecomunicații și

Tehnologia Informației

18.09.2025	Prof. Dr. Grazziela Sevastita Niculescu 	Prof. Dr. Grazziela Sevastita Niculescu 
Date of department approval	Head of department	
Date of approval in the Faculty Council	Dean	