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)				Reţele de comunicaţii Communications Networks			
2.2 Course Lecturer				Conf. dr. ing. Şerban Georgică OBREJA			
2.3 Instructor for practical activities				Conf. dr. ing. Şerban Georgică OBREJA; Ş.L. dr. ing. Seyedsalar SEFATI			
2.4 Year of studies	4	2.5 Semester	1	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	04.S.07.O.202		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3.5	Out of which: 3.2 course	2	3.3 seminary/laboratory	1.5
3.4 Total hours in the curricula	49	Out of which: 3.5 course	28	3.6 seminary/laboratory	21
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.					40
Tutoring					6
Examinations					5
Other activities (if any):					0

3.7 Total hours of individual study	51.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completing the following disciplines: Computer programming and programming languages Analogue and Digital Communications Information Theory Network and Internet architectures

4.2 Results of learning	Accumulation of the following knowledge: Basic programming knowledge Data representation in binary format, basic coding theory Analogue to digital conversion Basic Linux Internet architecture, IP addressing, TCP/IP protocols, IP routing, DNS, switching and bridging

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 Blackboard
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room with specific equipment, which must include: computers with Docker, Kathara, Wireshark applications

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)*

Familiarize students with the concepts required to design, implement, and manage IP-based telecommunications networks.

Understanding, implementing, and configuring telecommunications protocols.

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	**Demonstrate** basic knowledge of Communication Networks' domain. **Correlate and apply** the knowledge gained to understand and solve specific problems of the Communication Networks. They will be able to correlate and apply the knowledge to design, implement, configure, and operate telecommunications equipment and protocols, communication networks and systems, network applications, and services. It applies standardized methods and tools, specific to the field of communication networks, to carry out the evaluation and diagnosis process of a situation, depending on the identified/reported problems, and identifies solutions. **It argues and analyzes** coherently and correctly the context of the application of the basic knowledge of the Communication Networks field, using key concepts of the discipline and the specific methodology. **Oral and written** communication in English: students demonstrate understanding of the vocabulary related to the field of Communication Networks.

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 synthetically, as a result of a process of systematic analysis. Adaptation to new technologies and professional development, through continuous training using printed documentation sources, specialized software, and electronic resources. **Respect the principles of academic ethics**: correctly cite the bibliographic sources used in the documentation activity.

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 and describes the components of a communications network. Defines domain-specific notions: layered architectures, addressing, multiplexing, packet switching and circuit switching, routing, error, flow and congestion control, equipment types, Internet protocols and architecture, telecommunication networks architectures Describes the relations and interactions between the components of a communication network. Describes the main components of a TCP/IP communications network: the algorithms, the protocols, and the services. Describes the basic configurations of Internet protocols and services. Lists and describes the tools used to evaluate and diagnose a TCP/IP communications network.
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).* Identifies and defines the functional requirements of a communications network. Selects and groups information necessary to specify and design basic solutions for communications networks based on the TCP/IP stack. Uses specific principles in order to design an elementary network based on the TCP/IP stack. Implements and experimentally verifies identified solutions for an elementary network based on the TCP/IP stack. Analyzes and compares solutions for communication networks. Uses applications to emulate TCP/IP networks. Works productively in a team.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Select appropriate bibliographic sources and analyze them. 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. 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. Demonstrates real-life situation management skills (time management, collaboration vs. conflict in solving a practical problem).

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 direct exploration and indirect of reality (experiment, demonstration, modeling), but also on action-based methods, such as exercise, practical activities, and problem-solving.
In the teaching activity, lectures will be used, based on PowerPoint presentations or different videos that will be made available to the students. Each course will start with a recap of the chapters already covered, with an emphasis on the concepts covered in the last course.
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 learning efforts and the development of optimal collaborative and communicative relationships in a climate conducive to discovery learning. In the laboratory, students will receive assignments through which they will practice implementing, testing, and debugging emulated network topologies, to develop their practical skills in the field.
Teamwork skills will be practiced to solve different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction: The principle of layered design; OSI stack; TCP-IP stack	2
2	Physical layer: Basics of data transmissions; Wired and wireless transmissions	2
3	Telecommunication networks: PDH ierarchy; SDH ierarchy; Public Switched Telephone Netwoks	2
4	Data link level: logical data structuring; Flow Control, Error Control	4
5	Data link layer: Medium access controll, Ethernet, WiFi	2
6	Architecture of switching equipment: switch, router; Spanning Tree Protocol	2
7	Network layer: IP protocol; ARP protocol; DHCP; NAT; Routing Algorithms	4
8	QoS, Traffic modeling, Elements of queuing theory, Packet scheduling	2
9	Transport layer: TCP and UDP protocols, sockets; congestion control	4

10	Application layer: DNS service, e-mail service	4
	Total:	28

Bibliography:

Şerban Obreja, Retele de Comunicaţii, suport de curs electronic, https://curs.upb.ro/2021/course/view.php?id=9146.
Andrew S. Tanenbaum, "Computer Networks", fourth edition, Prentice Hall, 2003.
Larry L. Peterson & Bruce S. Davi, "Computer networks: a systems approach"– 4th ed., Elsevier, Inc., 2007.
O. Bonaventure, "Computer Networking: Principles, Protocols and Practice", 2011-2019. online: https://www.computer-networking.info/
J. Kurose, K. Ross, "Computer Networking", sixth edition, Pearson, 2013.
TCP/IP protocols, published by IETF online (http://www.ietf.org).

LABORATORY

Crt. no.	Content	No. hours
1	Introduction to Kathara Emulator – Specifying a Network Topology.	3
2	Static Routing. ARP protocol.	3
3	Dynamic routing. Zebra routing application. RIP protocol.	3
4	Traffic filtering in Linux using IPtables.	3
5	Linux Bridges. Spanning Tree. VLAN.	3
6	Dynamic routing. OSPF protocol.	3
7	DNS service	3
	Total:	21

Bibliography:

Şerban Obreja, Retele de Comunicaţii – lab platforms, platformă de laborator electronică, https://curs.upb.ro/2021/course/view.php?id=9146.
https://github.com/KatharaFramework/Kathara/wiki
https://linuxhint.com/tcpdump-command-tutorial/
https://linuxtect.com/tcpdump-tutorial-with-examples/
https://phoenixnap.com/kb/iptables-tutorial-linux-firewall
https://help.ubuntu.com/community/IptablesHowTo
https://wiki.linuxfoundation.org/networking/bridge
https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_ospf/configuration/xe-16/iro-xe-16-book/iro-cfg.html

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Understanding the theoretical notions associated with the operation of communication networks	Moodle Quiz	20
	Application of theoretical notions to specific problems	Moodle Quiz	40
	Experimental results reports	Evaluation of laboratory reports	20

11.5 Seminary/laboratory/project	Assessment of practical skills in network implementation and testing	Practical test	20
11.6 Passing conditions			
Obtaining 50% of the total score Obtaining 50% of the total lab score Attending at least four laboratory works			

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 for improving the existing situation in the field of telecommunications, the industrial branches of telecommunications/ IT system designer engineer, IT infrastructure administrator, design and implementation of telecommunications equipment, telecommunications systems operation, and maintenance engineer.
In the development of the content of the discipline, knowledge/aspects/phenomena described by the specialized literature were taken into account.
The course has a similar content to the courses held by Stanford University.
Through the concepts taught and through the practical activities of emulating some elementary TCP/IP networks from the laboratory, the development of the graduate's skills to manage practical situations that he may face in real life is considered to increase his contribution to improving the socio-economic environment..

Date	Course lecturer	Instructor(s) for practical activities
21.09.2026	Conf. dr. ing. Şerban Georgică OBREJA	Conf. dr. ing. Şerban Georgică OBREJA

Date of department approval	Head of department
22.09.2026	Conf. Dr. Serban Georgica Obreja

Date of approval in the Faculty Council	Dean
22.09.2026	Prof. Dr. Mihnea Udrea

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