SYLLABUS

1. Program information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	Communications
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Study program / Qualification	Telecommunications Technologies and Systems/ Engineer, Applied Electronics/Engineer
1.7 Form of education	IF – full-time education

2. Course information

2.1 Course title	Internet Protocols				Course code	TST-E46.00/ EA-E101.00
2.2 Course coordinator	*Professor Virgil DOBROTA, Ph.D. - Virgil.Dobrota@com.utcluj.ro*					
2.3 Seminar/ laboratory/ project/ practical activity coordinator	*Assist. Prof. Andrei-Bogdan RUS, Ph.D -Bogdan.Rus@com.utcluj.ro* *Assist. Robert BOTEZ, Ph.D. student - Robert.Botez@com.utcluj.ro*					
2.4 Year of study	4	2.5 Semester	7	2.6 Type of assessment		E
2.7 Course status	Formative category					DS
	Optionality					DOB

3. Estimated total time

3.1 Hours per week	4	of which:	3.2 Lecture	2	3.3 Seminar		3.3 Laboratory	2	3.3 Project		3.3 Practical training	
3.4 Hours per semester	56	of which:	3.5 Lecture	28	3.6 Seminar		3.6 Laboratory	28	3.6 Project		3.3 Practical training	

3.7 Time distribution (hours per semester) for individual study and assessment:	
(a) Assessment	3
(b) Study using textbook, course materials, bibliography, and notes	30
(c) Additional documentation in the library, on specialized electronic platforms, and in the field	10
(d) Preparation for seminars/laboratories, assignments, reports, portfolios and essays	28
(e) Tutoring	3
(f) Other activities	0

3.8 Total hours of individual study and assessment (sum of (3.7(a)...3.7(f))	74
3.9 Total hours per semester (3.4+3.8)	130
3.10 Number of credits	5

4. Prerequisites (where applicable)

4.1 curriculum	N/A
4.2 competencies	N/A

5. Requirements (where applicable)

5.1. for the development of the lecture	Cluj-Napoca
5.2. for the development of the seminar/ laboratory/ project	Cluj-Napoca

6. Specific competencies acquired

Professional competencies	C4. Design, implementation and operation of data, voice, video and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information C4.3 Explanation and interpretation of the main requirements and specific approach techniques for data, voice, video, multimedia transmissions C4.4 Use of the main specific parameters in evaluations based on the concept of quality of service in communications C4.5 Development of simple communications services C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks C5.1 Defining the principles of the main technologies for fixed and mobile telecommunications, through various transmission media C5.2 Explanation and interpretation of the technologies and of fundamental protocols for integrated fixed and mobile communications systems C5.3 Installation, configuration and exploiting of communications networks C5.4 Use of evaluation techniques and diagnostics for communications systems and equipment C5.5 Endowment with communications means of a location with a small/ medium degree of complexity
Transversal competencie	N/A

7. Expected learning outcomes

Knowledge	**K5.** The student/graduate describes, identifies, summarizes elementary concepts and methods regarding the architecture of computer systems, microcontrollers, programming languages and techniques and their application in concrete problems

Skills	**S17.** The student/graduate evaluates, based on specific performance criteria, the type of computing system, its architecture and the way of use necessary for an efficient solution of concrete problems. **S18.** The student/graduate specifies requirements, develops programs in general-purpose programming languages (C, etc.) and/or object-oriented (C++, Java, etc.), executes, debugs and interprets the results of the programs developed to solve a concrete problem. **S19.** Modify the scope of an information and communications technology (ICT) system by adding or reallocating additional ICT system components, such as network components, servers, or storage media to meet capacity demands.
Responsibility and autonomy	**R10.** The student/ graduate has honorable, responsible, and ethical behavior, in accordance with the law to ensure the reputation of the profession.

8. Course objectives (based on the grid of specific competencies acquired)

8.1 General objective of the course	Development of competences regarding Internet protocols
8.2 Specific objectives	1. Develop the skills and abilities necessary for configuring and using TCP/IP based networks (with IPv4, IPv6, Mobile IP, Mobile IPv6, TCP, UDP, SCTP, DHCP, DNS, ARP, ICMP, SSH, HTTP, HTTPS). 2. Development of skills and skills necessary for implementing a client-server application based on socket stream in IPv4 and IPv6 networks.

9. Contents

9.1 Lecture	**No. of hours**	**Teaching methods**	**Remarks**
1. Introduction. TCP/IP Architecture. Types of Protocols. Network Layer Routed Protocols. IP Protocol: Header Format	2	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, whiteboard
2. IPv6 Protocol: Header Format	2		
3. IPv6 Protocol: Extension Headers, Types of Addresses	2		
4. IPv6 Protocol: Unicast, Anycast, Multicast Addresses	2		
5. IPv6 Protocol: Conclusions. Mobile IPv4 Protocol: definitions, principles. Mobile IPv6 Protocol: definitions, principles	2		
6. IP in IP Encapsulation. Transport Layer Protocols. TCP Protocol: Header Format	2		
7. UDP Protocol: Header Format. SCTP Protocol: Header Format. Client-Server Architectures	2		
8. TCP Connection Management. Application Layer Routing Protocols. Routing Protocols: Definitions	2		

9.1 Lecture	No. of hours	Teaching methods	Remarks
9. Distance-Vector Based Routing Protocols: RIPv1, RIPv2, RIPng. Routing Loops Prevention	2		
10. Network Layer Routing Protocols. Link State Based Routing Protocols: OSPFv2, OSPFv3.	2		
11. Congestion Control. TCP Congestion Control. "Slow-Start" and Congestion Avoidance Algorithms	2		
12. Timers for TCP Congestion Control. Jacobson's Algorithm. Karn's Algorithm. Bakre-Badrinath's and Balakrishnan's Algorithms. Fast Retransmit and Fast Recovery Algorithms	2		
13. Future Internet. A Short History of Internet. Software Defined Networks SDN. OpenFlow Technology. Protocols for Future Internet	2		
14. Review. Examples of subjects given in the previous academic year	2		

Bibliography:

1. L. Peterson, B. Davie, *Computer Networks. A Systems Approach. Sixth Edition*. Systems Approach, 2024, [Online], Available: https://book.systemsapproach.org/
2. A.S. Tanenbaum, D.J. Wetherall, *Computer Networks. Sixth Edition*, Prentice Hall 2021
3. D. Medhi, K. Ramasamy, *Network Routing. Algorithms, Protocols, and Architectures. Second Edition*, Morgan Kaufman Publishers, 2018
4. L. Peterson, L. Brakmo, B. Davie, *TCP Congestion Control: A Systems Approach*, Systems Approach, 2022 [Online], Available: https://tcpcc.systemsapproach.org/.
5. L. Peterson, B. Davie, *Network Security: A Systems Approach,* Systems Approach, 2025 [Online], Available: https://security.systemsapproach.org/

On-line references:

1. V. Dobrota, *Internet Protocols,* Technical University of Cluj-Napoca, 2026-2027, https://el.el.obs.utcluj.ro/pi/en_index.htm

9.2 Laboratory	No. of hours	Teaching methods	Remarks
1. Organizing the laboratory teams. IPv4 Addresses	2		
2. Linux/Windows-Based Commands for TCP/IP (IPv4): w, who, finger, ping, traceroute, tracert, telnet, ssh, putty, ftp	2		
3. Linux/Windows-Based Commands for TCP/IP (IPv6). Wireshark Packet Analyzer	2		
4. Configuration of Linux/Windows Workstations/Servers for IPv4/IPv6	2		
5. Socket Applications for Client-Server Architectures: Berkeley sockets. Mini-project subjects	2		
6. Working for mini-projects (step 1): Realize the IPv6 client: connected to IPv6 server without sending commands.	2		
7. Working for mini-projects (step 2): Finalize the IPv6 client: sending commands and receiving their results	2		

9.2 Laboratory	No. of hours	Teaching methods	Remarks
8. Working for mini-projects (step 3): Realize the IPv4 server: connections and commands from Windows client, returning the confirmation.	2		
9. Working for mini-projects (step 4): Integration of IPv6 client into IPv4 server.	2		
10. Defending the mini-projects	2		
11. Data Link and Network Layers ARP Protocol. Network Layer ICMP Protocol. Application Layer DHCP Protocol. Application Layer DNS Protocol	2		
12. Application Layer Routing Information Protocol RIP	2		
13. Experiments with RIPv1, RIPv2, RIPng using Packet Tracer	2		
14. Recovery Laboratory. Questions	2		
On-line references: 1. V. Dobrota, *Internet Protocols,* Technical University of Cluj-Napoca, 2026-2027, https://el.el.obs.utcluj.ro/pi/en_index.htm 2. C. Negus, *Linux Bible*, 11th Edition, Sybex Publishers, 2025 3. R. Blum, C. Bresnahan, *Linux Command Line and Shell Scripting Bible, Fifth Edition*, Wiley Publishers, 2025			

10. Alignment of the course contents with the expectations of the epistemic community, professional associations, and representative employers in the field related to the program

The discipline content and the acquired skills are in agreement with the expectations of the professional Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods (and type of assessment: continuous/ summative)	11.3 Weight in final grade
11.4 Lecture	The level of acquired theoretical knowledge and practical skills	Theoretical Test (mark T) : 9 questions (summative)	T, max 10 pts. 50%
11.5 Laboratory/ Project	The level of acquired knowledge and abilities	Project (P1): oral and practical exam based on laboratory and project work (continuous) Grid Test (P2): 9 questions with multiple choice answers (summative)	P1, max. 5 pts. 25% P2, max. 5 pts 25%

11.6 Minimum performance standard

Qualitative point of view

Minimal theoretical and practical knowledge:

- ✓ 1. Understanding the basic concepts regarding Internet protocols
- ✓ 2. Development of skills and abilities for realizing a client-server application in C under Linux

Minimal acquired competences:

- ✓ Ability to develop simple TCP/IP applications
- ✓ Ability to analyze and improve performance of Internet protocols (IP, IPv6, ICMP, TCP, UDP, DNS, DHCP, RIP)

Quantitative point of view

- ✓ T ≥ 5
- ✓ P=P1+P2 ≥ 5, P2≥1.5

(T+P)/2≥ 4.5

Completion date:	**Course coordinators**	**teaching rank, title First name LAST NAME**	**Signature**
16.06.2026	Lecture	Professor Virgil DOBROTA, Ph.D.	
	Applications	Professor Virgil DOBROTA, Ph.D.	
		Assist. Prof. Andrei Bogdan RUS, Ph.D.	
		Assist. Robert BOTEZ, Ph.D. student	

Approval of the Head of the Department coordinating the course, only if this differs from the department organizing the study program	Head of Department

Date of approval by the Council of the Communications Department 19.06.2026	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval by the Council of the Faculty of Electronics, Telecommunications and Information Technology 30.06.2026	Dean, Prof. Ovidiu-Aurel POP, Ph.D.