SYLLABUS

1. Data about the program of study

1.1 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 Program of study / Qualification	Telecommunications Technologies and Systems/ Engineer Applied Electronics/Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E46.00/EA-E101.00

2. Data about the subject

2.1 Subject name	Internet Protocols						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Professor Virgil DOBROTA, Ph.D, Virgil.Dobrota@com.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assist. Prof. Andrei Bogdan RUS, Ph.D, Bogdan.Rus@com.utcluj.ro						
2.5 Year of study	4	2.6 Semester	7	2.7 Assessment	E	2.8 Subject category	DS/DI

3. Estimated total time

3.1 Number of hours per week	5	of which: 3.2 course	2	3.3 laboratory	2
3.4 To Total hours in the curriculum	56	of which: 3.5 course	28	3.6 laboratory	28

Distribution of time	hours
Manual, lecture material and notes, bibliography	25
Supplementary study in the library, online specialized platforms and in the field	10
Preparation for seminars / laboratories, homework, reports, portfolios and essays	28
Tutoring	3
Exams and tests	3
Other activities:	0

3.7 Total hours of individual study	69
3.8 Total hours per semester	125
3.9 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 curriculum	N. A.
4.2 competence	N.A.

5. Requirements (where appropriate)

5.1. for the course	Cluj-Napoca
5.2. for the seminars / laboratories / projects	Cluj-Napoca

6. Specific competences

Professional competences	**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 competences	N / A

7. Discipline objectives (as results from the key competences gained)

7.1 General objective	Development of competences regarding Internet protocols
7.2 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.

Contents

8.1 Lecture (syllabus)	**Teaching methods**	**Notes**
1. Introduction. TCP/IP Architecture. Types of Protocols. Network Layer Routed Protocols. IP Protocol: Header Format	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, whiteboard
2. IPv6 Protocol: Header Format		
3. IPv6 Protocol: Extension Headers, Types of Addresses		
4. IPv6 Protocol: Unicast, Anycast, Multicast Addresses		
5. IPv6 Protocol: Conclusions. Mobile IPv4 Protocol: definitions, principles. Mobile IPv6 Protocol: definitions, principles		
6. IP in IP Encapsulation. Transport Layer Protocols. TCP Protocol: Header Format		
7. UDP Protocol: Header Format. SCTP Protocol: Header Format. Client-Server Architectures		
8. TCP Connection Management. Application Layer Routing Protocols. Routing Protocols: Definitions		
9. Distance-Vector Based Routing Protocols: RIPv1, RIPv2, RIPng. Routing Loops Prevention		
10. Network Layer Routing Protocols. Link State Based Routing Protocols: OSPFv2, OSPFv3.		
11. Congestion Control. TCP Congestion Control. "Slow-Start" and Congestion Avoidance Algorithms		
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		
13. Future Internet. A Short History of Internet. Software Defined Networks SDN. OpenFlow Technology. Protocols for Future Internet		
14. Review. Examples of subjects given in the previous academic year		

References

1. V. Dobrota, *Retele digitale in telecomunicatii. Volumul III: OSI si TCP/IP. Editia a II-a*, Editura Mediamira, Cluj-Napoca 2003
2. L. Peterson, B. Davie – *Computer Networks. A Systems Approach*. *Sixth Edition*. Morgan Kaufmann, 2020.
3. A.S. Tanenbaum, D.J. Wetherall – *Computer Networks. Fifth Edition*, Prentice Hall 2010
4. D. Medhi, K. Ramasamy, *Network Routing. Algorithms, Protocols, and Architectures. Second Edition*, Morgan Kaufman Publishers, 2018

On-line references:

5. V. Dobrota, *Internet Protocols,* Technical University of ClujNapoca, 2021-2022, http://el.el.obs.utcluj.ro/pi/en_index.htm

8.2 Laboratory	**Teaching methods**	**Notes**
1. Organizing the laboratory teams. IPv4 Addresses	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, computers, magnetic board
2. Linux/Windows-Based Commands for TCP/IP (IPv4): w, who, finger, ping, traceroute, tracert, telnet, ssh, putty, ftp		
3. Linux/Windows-Based Commands for TCP/IP (IPv6). Wireshark Packet Analyzer		
4. Configuration of Linux/Windows Workstations/Servers for IPv4/IPv6		
5. Socket Applications for Client-Server Architectures: Berkeley sockets. Mini-project subjects		
6. Working for mini-projects (step 1): Realize the IPv6 client: connected to IPv6 server without sending commands.		
7. Working for mini-projects (step 2): Finalize the IPv6 client: sending commands and receiving their results		
8. Working for mini-projects (step 3): Realize the IPv4 server: connections and commands from Windows client, returning the confirmation.		

9. Working for mini-projects (step 4): Integration of IPv6 client into IPv4 server.		
10. Defending the mini-projects		
11. Data Link and Network Layers ARP Protocol. Network Layer ICMP Protocol. Application Layer DHCP Protocol. Application Layer DNS Protocol		
12. Application Layer Routing Information Protocol RIP		
13. Experiments with RIPv1, RIPv2, RIPng using Packet Tracer		
14. Recovery Laboratory. Questions		

On-line references:

1. V. Dobrota, *Internet Protocols,* Technical University of ClujNapoca, 2021-2022, http://el.el.obs.utcluj.ro/pi/en_index.htm
2. E. Nemeth, G. Snyder, T.R. Hein, B. Whaley, *UNIX and Linux System Administration Handbook.5th Edition*, Addison-Wesley 2018

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

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).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Theoretical Test (mark T) : 9 questions	T, max 10 pts. 50%
10.5 Laboratory/Project	The level of acquired knowledge and abilities	Project (P1): oral and practical exam based on laboratory and project work Grid Test (P2): 9 questions with multiple choice answers	P1, max. 5 pts. 25% P2, max. 5 pts 25%
10.6 Minimum standard of performance			

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

- ✓ $T \geq 5$
- ✓ $P=P1+P2 \geq 5$, $P2 \geq 1.5$
- ✓ $(T+P)/2 \geq 4.5$

Date of filling in:		**Title Surname NAME**	**Signature**
27.09.2021	Course	Professor Virgil DOBROTA, Ph.D	
	Applications	Professor Virgil DOBROTA, Ph.D	
		Assist. Prof. Andrei Bogdan RUS, Ph.D	

Date of approval in the Department of Communications 27.09.2021	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 27.09.2021	Dean Prof. Gabriel OLTEAN, Ph.D.