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	Masters
1.6 Programme of studies	Advanced Wireless Communications

2. Date despre disciplină

2.1 Course name (ro) (en)				Servicii şi protocoale avansate pentru reţele de telecomunicaţii Advanced Communication Networks, Protocols and Services			
2.2 Course Lecturer				Prof. Dr. Marius-Constantin Vochin			
2.3 Instructor for practical activities				Conf. Dr. ing. Şerban Georgică Obreja			
2.4 Year of studies	1	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	2		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	2.5	Out of which: 3.2 course	1.50	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	35.00	Out of which: 3.5 course	21	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.					60
Tutoring					0
Examinations					5
Other activities (if any):					0

3.7 Total hours of individual study	65.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Programming Languages, Data Communications, Architectures for Networking and Internet-basics, Computer architectures
4.2 Results of learning	Internet Architectures, Routing and switching, Python programming, Mobile communications, Operating systems

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

5.1 Course	Not applicable
5.2 Seminary/ Laboratory/Project	Mandatory attendance at laboratories

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)*

Development of the expertise gained at previous courses (basics) , by training in advanced wireless communications (technologies: WiFi, 3g, 4G); acquiring knowledge on novel Future Internet technologies (virtualization, SDN, NFV, Mobile cloud computing, 5G) and new services supported by such infrastructures.

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	Capabilities for : installation, configuration, exploitation, development, design, implementation of advanced networks, protocols and services, with focus on wireless systems. Programming basic functions for software defined networks.
Transversal (General) Competences	Cooperation capabilities with experts in the same fields, team working abilities for wireless communication domain. 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.* Gaining of specific engineering: advanced communications architectures protocols, network planning, configuring parameters and protocols, functional testing, fault diagnosis, virtualization solutions for L2 and L3, functional testing, error diagnosis.

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 advanced communications network and service Analyzes and compares solutions for advanced communication networks and services Hands-on experimental validation Results interpretation and analisis Uses applications to emulate TCP/IP networks and software defined networks Team work
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* State of the art solution identifiying and analisis Selects appropriate bibliographic sources and analyze them Demonstrates responsiveness to new learning contexts Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved Good collaboration with collegues and staff Ethical writing and usage of academic papers

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.)*

Teaching is based on using the projector and live presentation.

Qs and As methods are used. Course materials are lecture notes and proposed exercises (theoretical and problems).

All materials are available in digital format.

Laboratory work is done in teams of two students each, having available a computer with Linux operating system.

Equipment used for the study of technologies and network protocols: Cisco switches and routers, IBM, Huawei.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction: Layered networking and multiple plane architectures. revision (Examples TCP/IP, NGN, 3G, 4G). Business models and actors, service contracts. Basics of new technologies: Internet of Things, Cloud computing, Vehicular communications, Basics of SDN and NFV technologies.	3
2	Main networking technologies and protocols- revision: WAN, MAN ,LAN ,PAN area networks infrastructures. Main L2, L3, L4 protocols (for unicast and multicast)	3

3	Services and Applications: Classic services and applications- revision. New services and applications: Data, Web services, Content and Media oriented: VoiP, AVC, VoD, Video streaming, IPTV, social networks applications, etc.	2
4	Architectures and technologies for WAN mobile networks: Revision- 2G, 3G. Mobility management. Networks and 4G technologies (architecture- user plane, control plane; addressing, physical layer elements; terminal equipments, E-UTRAN, core networks). Integrated services over LTE. 5G technologies.	6
5	Architectures and technologies for future Internet networks: Virtualization concepts at L2, L3. Software Defined Networks. Network Functions Virtualization (NFV). Cloud computing: IAAs, PaaS, SaaS, CaaS- services, NIST architecture, ITU-T architecture, examples. Mobile cloud computing.	7
	Total:	21
Bibliography:		

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Introduction to Kathara network emulator; Tools for testing and analyzing TCP/IP.	2
2	Implementing basic routing functions in Kathara emulator	2
3	Traffic filtering with Iptables	2
4	Introduction to Mininet emulator for SDN networks	2
5	Controlling Open Flow devices in Mininet emulator	2
6	Implementing basic SDN functions using POX SDN controller	2
7	Final test	2
	Total:	14
Bibliography:		

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	- Understanding the theory associated with the functioning of telecommunications networks;	-tests during the semester	20
	- Knowledge of the application of theory to specific problems;	-Final Exam	40
11.5 Seminary/laboratory/project	Conducting laboratories	Lab reports	20
	Individual practical test on the final laboratory day	Practical test	20
11.6 Passing conditions			
- 50 points out of 100 under License Regulation of UPB.			

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)

Global telecommunications market has significantly grown in recent years, and in particular mobile communications and services. resulting in a very dynamic industry that requires a large number of specialists in telecommunications systems. In Romania many operators are active and they need skilled engineers having expertise in: exploitation, maintenance, design and development, implementation, application development. The ACNPS offers to the students knowledges related to architectures, design and functioning of the wireless networks and supported services, their embedding in end-to-end systems, and also specific services and applications. This knowledge arec actually required from the graduates which will work in telecommunication networks and systems.

Date	Course lecturer	Instructor(s) for practical activities
	Prof. Dr. Marius-Constantin Vochin	Conf. Dr. ing. Șerban Georgică Obreja
Date of department approval	Head of department	
Date of approval in the Faculty Council	Dean	