COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Department of Informatics and Computer Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE		**SEMESTER**	**8th**
COURSE TITLE	Software Defined Networking		
INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	
Laboratory Exercises		1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		4	5
COURSE TYPE general background, special background, specialised general knowledge, skills development	Special background, skills development		
PREREQUISITE COURSES:	Computer Networks I, II		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (English)		
COURSE WEBSITE (URL)			

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Software-based networking (SDN) is an innovative approach to managing network resources that is bringing about massive changes both in the field of research and in the analysis, design and implementation of the network systems of the future. By separating the control plane from the forwarding and data planes, SDN technology provides a global approach to today's complex network services resulting in the simplification of monitoring and network management. This new technology is already being implemented in the industry by major manufacturers of network infrastructure devices. At the same time, implementations based on open source software have been implemented in wide area networks and data centers. The student will have the possibility to delve into new technologies (SDN-NFV) based on the virtualization of processing and network resources, in the light of the requirements of network services in the context of new generation (5G) networks. Next, it will study methodologies for analysis, design and implementation of dynamic networks to support multiple users with different service requirements (QoS). In addition, in the context of research work, he will delve into issues related to quality of experience (QoE) requirements, such as congestion control, traffic monitoring/shaping, security. In particular, upon successful completion of the course the student will:

- have specialized knowledge and deep understanding of basic and advanced concepts of SDN architecture
- delve into the concepts of network and processing resource virtualization

- Understand the basic concepts of NFV architecture
- Understand the separation between the data/control planes
- Analyze the operation of the OpenFlow protocol and program network devices (sdn switches)
- Understand SDN Controller architecture
- Classify, compare and evaluate different open source implementations of SDN Controllers
- Combine analysis, design and implementation methodologies of advanced systems based on the SDN architecture with the aim of satisfying specific requirements (QoS, QoE, security, etc.)
- Combine knowledge and address complex issues, as well as formulate judgments, on issues related to intelligent programmable networks and communicate clearly and concisely his conclusions for the implementation of original ideas.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	Project planning and management
	Respect for difference and multiculturalism
	Respect for the natural environment
Adapting to new situations	Showing social, professional and ethical responsibility and sensitivity to gender issues
Decision-making	
Working independently	Criticism and self-criticism
Team work	Production of free, creative and inductive thinking
Working in an international environment	……
Working in an interdisciplinary environment	Others…
	…….
Production of new research ideas	

- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas
- Working in an interdisciplinary environment

(3) SYLLABUS

1 Introduction

From traditional networks to software-defined networks, modern Data Centers and their requirements, autonomous and dynamic forwarding tables, SDN implementations and applications, resource virtualization in next-generation (5G) networks.

2. Software defined networks

Key Features of SDN Technology (Data/Control Layers, Operation, Devices, Software, Applications), IETF SDN Framework, Alternative SDN Approaches (API, Hypervisor-Based etc.)

3. OPEN FLOW

The OpenFlow protocol, open source software (Open Daylight/Floodlight Controllers, Mininet, OpenVSwitch), data traffic management (load balancing)

4. Alternative SDN technologies

Disadvantages of SDN architecture, approaches based on pre-existing protocols and APIs

5. Network Functions Virtualization (NFV)

Definitions NFV terminology, OPNFV, network services – Network Services (NS)/Virtual Network Functions (VNF), differences between SDN and NFV approaches

6. SDN in DATA CENTERS

Definition of Data Center, management-sharing of resources to multiple users in Data Center, Openstack, Docker, Kubernetes, VMware, SDN in Data Centers, VLANs, EVPN, VxLAN, NVGRE

7. SDN PROGRAMMING

Open source SDN implementations (programming languages, tools, simulators and applications), open source implementations (switches, controllers, applications)

8. Design SDN applications

Analysis - application categorization (eg active/proactive), implementation of applications using the NBI provided by the SDN controller.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	**Laboratory exercises in SDN (Mininet, Diverse Controllers)** **e-class: electronic platform for asynchronous distance learning**
TEACHING METHODS The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	**Activity** / **Semester workload** Lectures: 26 Exercices: 13 Lab Exercises: 13 Project: 33 Study: 40 Course total: **125**
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	I. Final written exam in theory (70%) which includes: - Short answer questions that assess understanding of key concepts of optical communications networks - Solving problems related to system performance analysis II. Evaluation of individual and group assignments – lab exercises (30%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Paul Goransson and Chuck Black, —Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, —SDN: Software Defined Networks, O'Reilly Media, 2013.

- Related academic journals:

1. Computer Networks, Elsevier
2. IEEE/ACM Transaction on Networking
3. IEEE Journal of Communications and Networks