Course guide
300046 - PX - Network Planning

Last modified: 01/06/2023

Unit in charge:	Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit:	744 - ENTEL - Department of Network Engineering.

Degree: BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 4.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer:	Definit a la infoweb de l'assignatura.
	Definido en la infoweb de la asignatura.
	Defined at the School web info of the course.
Others:	Definit a la infoweb de l'assignatura.
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PRIOR SKILLS

Understanding the basic concepts of access and transport networks, teletraffic, and telematics applications and services.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

TEACHING METHODOLOGY

The classes consist essentially of lecture classes by the teacher (encouraging the active participation of the students), although students will also be asked to work certain parts of the subject on their own (autonomous learning), based on the materials provided by the professors (slides, documents about cases of use / products, chapters of books, etc.).

The concepts of theory will be reinforced by solving problems, which will in many cases be the solution, thus providing a self-evaluation of the learning achieved in each unit and activity.

The laboratory sessions (hands on) will be done in pairs and software simulation and planning tools and SDN / NFV network environments will be used.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student must be able to:

· Modeling the rules governing the packed switching networks from the point of view of the user and the operator.

· Know the basic elements of Theory of Graphs and apply them to the analysis of networks and services.

· Use a specific simulation environment used in the modeling of networks with graphs.

· Know some models to evaluate social networks.

· Identify the bases and requirements for planning a packet switching network.

· Identify and apply the main algorithms for allocation of capacities, flows and topology used in the design of a packet switching network.

· Use a specific simulation environment used in network planning.

. Understand and configure the architecture of networks defined by softare (SDN) and virtualized network functions.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	13,0	13.00
Self study	56,0	56.00
Hours large group	26,0	26.00
Guided activities	5,0	5.00

Total learning time: 100 h

CONTENTS

Introduction to the planning and dimensioning of networks and services

Description:

Evolution of networks and services. Internet
Virtualization & Federation
Software Defining Networks. Network function virtualization

Full-or-part-time: 6h
Theory classes: 2h
Self study : 4h

Mathematical tools for characterizing and modelling networks and services

Description:
Introduction to Graph Theory. Definitions
Degree distribution
Minimum cut set. Maximum flow
Feature extraction. Neighbourhood, centrality, hubs
Models of the WWW. Page Rank.
Models of Internet. Small world. Scale-free networks
Simulation and analysis tools: Pajek
Analysis of GEANT and/or a social network
Exercises. Examples: www, Netflix

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 3h
Guided activities: 1h
Self study : 14h

Software-defined networking (SDN) & NFV

Description:
Concept, architecture, applications
Virtualization. Definition. Features
Openflow protocol & interfaces. Description. Controllers. OpenDaylight
Analytical model of SDN
Design and evaluation of a SDN-LAN
Emulation tools and deployment: mininet & Open vSwitch

Full-or-part-time: 30h
Theory classes: 8h
Practical classes: 4h
Guided activities: 2h
Self study : 16h

Dimensioning and planning of packet networks

Description:
Dimensioning and planning of packet networks
Model of a packet switched network
Traffic matrices
Analysis of delay
Optimization problems
Capacity Assignment
Flow Assignment
Internet model
Topology
Robustness
Exercises
Applications with Net2Plan

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 3h
Guided activities: 1h
Self study : 14h

Network services

Description:
Network function virtualization (NFV). Architecture. MANO
Service Function Chaining (SFC). Architecture
Network Service Header (NSH). Protocols and functionalities
Use cases: Open MANO, OSM, OpenStack

Full-or-part-time: 16h
Theory classes: 4h
Practical classes: 3h
Guided activities: 1h
Self study : 8h

GRADING SYSTEM

Definit a la infoweb de l'assignatura.
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BIBLIOGRAPHY

Basic:
- Stallings, William. Foundations of modern networking : SDN, NFV, QoE, IoT, and Cloud. Indiana: Pearson, 2016. ISBN 9780134175393.
- Chayapathi, Rajendra; Shah, Paresh; Farrukh Hassan, Syed. Network functions virtualization (NFV) with a touch of SDN. Boston: Addison-Wesley, [2017]. ISBN 9780134463056.
- Newman, M. E. J. Networks : an introduction. Oxford ; New York: Oxford University Press, 2010. ISBN 9780199206650.
- Nadeau, Thomas D. SDN : software defined networks. Sebastopol: O'Reilly, 2013. ISBN 9781449342302.
- Nooy, Wouter de; Mrvar, Andrej; Batagelj, Vladimir. Exploratory social network analysis with Pajek. Rev. and expanded 2nd ed. New York: Cambridge University Press, 2011. ISBN 9780521174800.

Complementary:
- Barrat, Alain; Barthelemy, Marc; Vespignani, Alessandro. Dynamical processes on complex networks. Cambridge: Cambridge University Press, 2008. ISBN 9780521879507.
- Walrand, Jean; Varaiya, Pravin Pratap. High-performance communication networks [on line]. 2nd ed. San Francisco, Calif.: Morgan Kaufmann, 2000 [Consultation: 26/07/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9781558605749/high-performance-communication-networks. ISBN 1558605746.
- Kumar, Anurag; Manjunath, D.; Kuri, Joy. Communication networking : an analytical approach. Amsterdam: Elsevier/Morgan Kaufmann Publishers, 2004. ISBN 9780124287518.
- Kadushin, Charles. Understanding social networks : theories, concepts, and findings. New York: Oxford University Press, 2012. ISBN 9780195379471.

RESOURCES

Hyperlink:
- mininet. http://mininet.org/- Pajek. http://vlado.fmf.uni-lj.si/pub/networks/pajek/- OpenFlow Switch Consortium. https://www.opennetworking.org/