Course guide
230151 - SIX - Network Simulation

Last modified: 25/05/2023

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

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

REQUIREMENTS

NETWORK APPLICATIONS AND SERVICES - Precorequisite
PROBABILITY AND STATISTICS - Precorequisite

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
1. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 3. To identify and model complex systems. To Identify methods and tools appropriate to pose the equations and descriptions associated with the models and to solve them. To carry out qualitative analysis and approaches. To determine the uncertainty of the results. To formulate hypotheses and experimental methods to validate them. To set up and manage undertakings. To identify major components and establish priorities. To develop critical thinking.
2. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.

TEACHING METHODOLOGY

Theoretical classes
Laboratory classes
Individual homework
Exercises
Long-answer examination (Final Exam)
Laboratory practice

LEARNING OBJECTIVES OF THE SUBJECT

The aim of this course is to train students in the methods of evaluation of networks and systems through simulation.
First the types of simulation are presented and so the necessary generation of random variables to feed them. Next you will see how you can design experiments and finally, using this knowledge, how you can model and evaluate the most typical communication networks.

Learning outcome:

- It has capacity to build, operate and manage networks, services, processes and telecommunications applications from the point of view of telematic services.
- Understand and apply the concepts of quality of service in different network environments.
- Use easily necessary to build, operate and manage tools telematic services, especially those related to Internet, web and multimedia information.
- Familiarization with the protocols and communication interfaces at different levels of network architecture and able to describe, schedule, validate and optimize them.
- Know the technological progress of transmission, switching and process for improving networks and telematic services.
- Identify and model complex systems. Conducts analysis and qualitative approaches, establishing the uncertainty of the results. Raises hypotheses and experimental methods to validate them. Identifies the major components and establishes commitments and priorities.
- Design experiments and measurements to test hypotheses and validate the operation of equipment, processes, systems or services in the information and communication technologies field. Select the equipment and appropriate and performs advanced data analysis software tools.

STUDY LOAD

Type	Hours	Percentage
Hours large group	26,0	17.33
Self study	98,0	65.33
Hours small group	26,0	17.33

Total learning time: 150 h

CONTENTS

Tema 1. Introduction to Simulation.

Description:
Systems, models and simulation
Monte Carlo and the discret event simulation
Development environments

Laboratory:
Construction of a system by means of the network development environment OMNeT++

Full-or-part-time: 13h
Theory classes: 3h
Laboratory classes: 2h
Self study : 8h

Tema 2. Random variables generation in simulation

Description:
Random number generation
Methods of generation of discrete and continuous random variables variables
Uniformity and independence verification for random generators

Laboratory:
Generation and analysis of random variables

Full-or-part-time: 40h
Theory classes: 10h
Laboratory classes: 10h
Self study : 20h

Tema 3.Experiments design

Description:
Basic concepts and methods
Initial conditions, transient and steady state
Horizon time for the simulaction
Results analysis

Laboratory:
Study of a system with theoretical support

Full-or-part-time: 31h
Theory classes: 5h
Laboratory classes: 6h
Self study : 20h

Tema 4. Modelling in communication networks.

Description:
Voice, video and data models
Wired network models
Wireless network models
Available models in a development environment

Laboratory:
Simulation project

Full-or-part-time: 56h
Theory classes: 12h
Laboratory classes: 12h
Self study : 32h

ACTIVITIES

(ENG) Exercises

Description:
Non-classroom complementary activities

(ENG) Laboratory practice

Description:
Experimental work in a laboratory

(ENG) Short-answer examination (Exam)

Description:
Exam

Full-or-part-time: 2h
Theory classes: 2h

(ENG) Laboratory practice

Description:
Tema 1. Introduction to simulation.

(ENG) Laboratory practice

Description:
Tema 2. Random variables generation in simulation.

(ENG) Laboratory practice

Description:
Tema 4. Modelling in communication networks.

(ENG) Laboratory practice

Description:
Tema 3.Experiments design.

(ENG) Long-answer examination (Final Exam)

Description:
Final Exam

Full-or-part-time: 2h
Theory classes: 2h

GRADING SYSTEM

Complementary activities: 30%
Laboratory practice: 40%
Final examination: 30%
In this subject the following generic competences will be evaluated:
- Capacity to identify, formulate and solve engineering problems (Level High)
- Experimentation and knowledge of instrumentation (Level High)

BIBLIOGRAPHY

Basic:
- Ross, S.M. Simulation. 4th ed. San Diego: Academic Press, 2006. ISBN 0125980639.
- Law, A.M. Simulation modeling and analysis. 5th ed. New York: McGraw-Hill, 2015. ISBN 1259254380.
- Knuth, D.E. The art of computer programming: seminumerical algorithms (Vol. 2). 3rd ed. Reading, Mass.: Addison-Wesley, 1998. ISBN 0201896842.

Complementary:
- Rubinstein, R.Y.; Melamed, B. Modern simulation and modeling. New York: John Wiley & Sons, 1998. ISBN 0471170771.
- Morgan, B.J.T. Elements of simulation. London; New York: Chapman and Hall, 1986. ISBN 0412245906.
- Fishman, G.S. Discrete-event simulation: modeling, programming and analysis. New York: Springer, 2001. ISBN 0387951601.
- Rubinstein, R.Y; Kroese, D.P. Simulation and the Monte Carlo method [on line]. 3rd ed. Hoboken, NJ: John Wiley & Sons, 2017 [Consultation: 23/03/2017]. Available on: http://onlinelibrary.wiley.com/book/10.1002/9781118631980. ISBN 9781118631980.