Last update: 06-05-2019

230066 - AAX - Network Analysis and Evaluation

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 744 - ENTEL - Department of Network Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: ESTEVE PALLARES SEGARRA

Others: LUIS JAVIER DE LA CRUZ LLOPIS
JOSE LUIS MELUS MORENO

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.
12 CPE N3. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how to develop a method for analysing and solving problems that is systematic, critical and creative.

Teaching methodology

Lectures
Application classes
Laboratory classes
Laboratory sessions
Individual work (not presential)
Group work (not presential)
Short-answer tests (Control)
Short-answer tests (Test)
Extended-response tests (Final Exam)

Learning objectives of the subject

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The aim of this course is to train students in methods of design, dimensioning and evaluation of data communication networks. First of all, the parameters of interest and the mathematical tools are studied. Then, using this knowledge, real transmission systems are modelled and studied, as well as congestion control mechanisms and multiple access techniques.

Learning outcomes:
- Ability to build, operate and manage networks, services, processes and telecommunications applications from the point of view of telematic services.
- Ability to apply management techniques, signaling, switching and network routing in fixed and mobile environments.
- Ability to perform network analysis using traffic engineering (graph theory, queuing theory and teletraffic).
- Knowledge in charging systems design and reliability.
- Knowledge of the technological progress of transmission, switching and the process to improve networks and telematic services.
- Undertake tasks from the guidelines set by the teacher, taking the required time and resources. Assess own strengths and weaknesses and act accordingly.
- Identify, model and set out problems from open situations. Explore and apply alternatives to solve them. Be able to use approximations.

Study load

Total learning time: 150h	Hours large group:	52h	34.67%
	Hours small group:	13h	8.67%
	Self study:	85h	56.67%

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Content

Lesson 1. Introduction.

Learning time: 6h

Theory classes: 2h
Laboratory classes: 0h
Guided activities: 0h
Self study : 4h

Description:
Access and transport networks.
Transmission system model.
Parameters of interest.

Lesson 2. Transmission systems modelling and evaluation.

Learning time: 65h

Theory classes: 22h
Laboratory classes: 7h
Guided activities: 0h
Self study : 36h

Description:
Markov processes and Birth-Death processes.
Birth-Death processes in equilibrium.
Delay systems.
- M/M/1
- M/M/oo
- M/M/m

Loss systems
- M/M/1/K
- M/M/m/m

Finite population
- M/M/1//M

Semimarkovian systems
- M/G/1
- Non-preemption priority
- Preemption priority

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Lesson 3. Network functions analysis.	Learning time: 36h Theory classes: 12h Laboratory classes: 4h Guided activities: 0h Self study : 20h

Description:
Burke's theoreme.
Number of hops through the network and transit time.
Load balancing.
Congestion control.
- Token bucket.
- Slow-down mechanisms.
- Sliding window mechanisms (fixed or variable size).

Lesson 4. Multiple access techniques evaluation.	Learning time: 40h Theory classes: 16h Laboratory classes: 0h Guided activities: 0h Self study : 24h

Description:
Deterministic or contentionless techniques.
- TDMA.
- FDMA.
- Polling.
Random or contention techniques.
- Aloha and slotted aloha.
-CSMA.
-CSMA/CD and CSMA/CA.

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Planning of activities

LABORATORY SESSION 1. STUDY OF THE PROBABILITY DENSITY FUNTION OF RANDOM VARIABLES WITH MATLAB.

Description:
Random variables generation.
Functions and scripts in MATLAB.

Support materials:
MATLAB.

LABORATORY SESSION 2. SIMULATION AND PERFORMANCE EVALUATION OF DELAY SYSTEMS.

Description:
Delay systems M/M/1 and M/M/oo and M/M/m are thoroughly studied.

Support materials:
Scalev Lite simulation tool.
MATLAB.

Descriptions of the assignments due and their relation to the assessment:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

LABORATORY SESSION 3. SIMULATION AND PERFORMANCE EVALUATION OF LOSS SYSTEMS.

Description:
Loss systems M/M/1/K and M/M/m/m are thoroughly studied.

Support materials:
Scalev Lite simulation tool.
MATLAB.

Descriptions of the assignments due and their relation to the assessment:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

LABORATORY SESSION 4. SEMIMARKOVIAN AND PRIORITY SYSTEMS.

Description:
M/G/1 and priority systems are thoroughly studied.

Support materials:
Scalev Lite simulation tool.
MATLAB.

Descriptions of the assignments due and their relation to the assessment:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

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LABORATORY CONTROL.

Description:
Laboratory control to be done individually by the students.

THEORETICAL MIDTERM CONTROL.

Description:
Theoretical midterm control to be done individually by the students.

Qualification system

- This course has evaluation of theory (80%) and of laboratory (20%).
- The theoretical grade consists of a midterm control (40% of the grade of theory) and a final exam (60% of the grade of theory).
- The laboratory grade consists of a laboratory control (80% of the laboratory grade) and a subjective grade assigned by the professor (20% of the laboratory grade).
- The laboratory attendance must be 100% to pass the course, unless the absences are justified in writing.

This course evaluates these generic skills:
- Ability to identify, formulate and solve engineering problemes (Level 2). For the evaluation, the grades obtained in the different tests and exams done during the semester, in which engineering problems appear, are taken into account.
- Experimentation and knowledge of tools and instruments (Level 2). The evaluation is carried out based on the work done in the laboratory.

Bibliography

Basic:

Bertsekas, D. P.; Gallager, R. G. Data networks. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, 1992. ISBN 0132009161.

Kleinrock, L. Queueing systems: vol 1: theory. New York: John Wiley & Sons, 1975. ISBN 0471491101 (V. 1).

Complementary:

Kleinrock, L. Queueing systems: vol 2: computer applications. New York: John Wiley and Sons, 1976. ISBN 047149111X (V.2).

Walrand, J.; Varaiya, P.P. High-performance communication networks [on line]. 2nd ed. San Francisco, CA: Morgan Kaufmann, 2000 [Consultation: 16/02/2015]. Available on: <http://www.sciencedirect.com/science/book/9781558605749>. ISBN 1558605746.