Universitat Autònoma de Barcelona

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Telecommunications Services

Code: 102700
ECTS Credits: 6

Degree	Type	Year	Semester
2500898 Telecommunication Systems Engineering	OB	4	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Joan Protasio Ramirez

Prerequisites

The student should have completed Fonaments de Xarxes (Network Fundamentals) and have an adequate level of programming.

Objectives and Contextualisation

- Review the architecture and protocols of telematic networks.
- Briefly introduce Security in services related to multimedia information
- Know the mechanisms of coding and storage of multimedia information
- Introduce the processing of multimedia information
- Know different transport mechanisms of multimedia information
- Introduce the concept of Quality of Service in multimedia networks
- Know some of the classic, new generation and security services related to multimedia information

Competences

- Analyse and evaluate the social and environmental impact of technical solutions.
- Apply the necessary legislation in the exercise of the telecommunications engineers profession and use the compulsory specifications, regulations and standards.
- Communication
- Design and dimension multiuser communication systems using the principles of communication theory under the restrictions imposed by the specifications and the need to provide a quality service.
- Develop ethics and professionalism.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Draft, develop and sign projects in the field of telecommunications engineering that, depending on the speciality, are aimed at the conception, development or exploitation of telecommunication and electronic networks, services and applications.

- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Perform measurements, calculations, estimations, valuations, analyses, studies, reports, task-scheduling and other similar work in the field of telecommunication systems.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineers work.
- Work in a multidisciplinary group and in a multilingual environment, and communicate, both in writing and orally, knowledge, procedures, results and ideas related with telecommunications and electronics.
- Work in a team.

Learning Outcomes

1. Adapt to multidisciplinary environments.
2. Apply the techniques in networks, services, processes and telecom applications in both fixed and mobile environments, personal, local or long distance with different band widths, including telephony, radio, television and data are based from the point of view transmission systems.
3. Assume and respect the role of the different members of a team, as well as the different levels of dependency in the team.
4. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
5. Consider and evaluate different technical solutions for the provision of telecommunications services and select those that offer adequate commitment to social and environmental impact.
6. Construct, operate and manage networks, services, processes and telecom applications, understood these as systems of recruitment, transportation, representation, processing, storage, management and presentation of multimedia information, from the point of view of the transmission systems.
7. Critically evaluate the work done.
8. Develop critical thinking and reasoning.
9. Develop curiosity and creativity.
10. Develop independent learning strategies.
11. Develop the capacity for analysis and synthesis.
12. Differentiate and understand the significance of measurements and assessments of telecommunications networks to Formenta and ensure their optimal design.
13. Discuss and apply cryptography systems aimed at improving the safety of a telecommunication network.
14. Discuss in multidisciplinary groups knowledge, procedures, results and ideas related to telecommunications networks and services.
15. Distinguish the different nature of the problems of dimensioning and routing for each of the different types of networks and make decisions and initiatives to improve the operation and provision of telecommunications networks.
16. Efficiently use ICT for the communication and transmission of ideas and results.
17. Evaluate the advantages and disadvantages of different conceptual and technological options for different telecommunication applications.
18. Manage available time and resources.
19. Manage networks, services, processes and telecom applications according to the laws and regulations both domestically and internationally.
20. Recognize telecommunication services, based on the feedback systems, transport, representation, processing, storage, management and presentation of multimedia information.
21. Respect diversity in ideas, people and situations.
22. Use communication and computer applications (office automation, databases, advanced calculation, project management, display, etc.) to support the development and exploitation of telecommunication and electronic networks, services and applications.
23. Work autonomously.
24. Work cooperatively.

Content

The course is divided into 7 subjects, which revolve around multimedia information systems and services:

1. Presentation
2. Introduction
    1. Layer architecture
    2. Network interconnection
    3. Classification of networks
3. Security
    1. Introduction
    2. Threats and Protection of resources
    3. Basic cryptography
    4. Symmetric key cryptography
    5. Public key cryptography
    6. Digital signature
    7. No denial
    8. Summary of techniques
    9. Secure communication protocols
    10. Secure email
    11. Key management
    12. Public key infrastructure (*Public-key Infrastructure*, PKI)
4. Multimedia Information
    1. Introduction
    2. Data
    3. Audio
    4. Images
    5. Video
    6. Compression
    7. Performance
5. Information Processing
    1. Introduction
    2. The Client/Server model
    3. Distributed data processing
    4. Distributed data
    5. Additional considerations
6. Transport of Information
    1. Introduction
        1. Communication system
        2. Data communication
        3. Data coding
        4. Error control
    2. Transmission Control Protocol (TCP)
    3. Flow control
    4. Congestion control
7. Quality of Service in Multimedia Networks
    1. Introduction
    2. Internet architecture
    3. Internet Protocol (IP)
    4. Quality of Service
8. Services
    1. Introduction
    2. Classic services
        1. Email
        2. HTTP
    3. Multimedia services
        1. Content distribution networks
        2. *Real-time Transport Protocol* (RTP)
        3. Real-time video playback
        4. Voice over IP (VoIP)

4. New generation services
    1. Intranets/Extranets
    2. Service-oriented architectures
    3. Grid computing and Cloud computing
    4. Opportunistic Networks (OppNet)
5. Security services
    1. Secure Sockets Layer (SSL/TLS)
    2. Virtual private networks (VPN)
    3. Firewall
    4. Intrusion detection systems
    5. Cryptocurrencies

Methodology

During the course, we will carry out the following activities:

- Theory sessions, where the teacher will provide information on the knowledge of the subject and on strategies to acquire, expand and organise this knowledge. The active participation of the students will be encouraged during these sessions, for example posing discussions in those points that admit diverse technological solutions.
- Problems sessions, where the students will have to actively take part to consolidate the knowledge acquired by solving, presenting and debating related problems. Problems are distinguished from the exercises, which can be considered as trivial problems. The problems will often admit several solutions and may cause debate among the students.
- Laboratory practical sessions, where small projects will be proposed to be analysed and developed by the students in group. The sessions will be previously prepared, documented and programmed by the teacher, and the students will have to prepare them before attending, reviewing the related theoretical knowledge and the basic technical aspects of the development. The laboratory sessions should serve students to achieve the skills of the subject and contribute to achieve some skills such as autonomous work.
- Preparation of the portfolio of the subject, in a virtual way through a wiki, a collaborative web tool. Students will have to work autonomously in teams in the research and the preparation of the corresponding material of the evidences of his theory and problems learning, and in the study of this material. The evidences include extensions of the different topics exposed to the sessions of theory and collaborative problem solving. The teacher will monitor the work of the different teams, provide feedback to the teams depending on the task done and the doubts they raise or the errors they manifest. The preparation of the portfolio should serve students to help achieve the competencies of the subject. The teaching methodology and evaluation are closely linked to the wiki-based virtual portfolio system, which is the cohesive element of the different teaching activities during the course, and which allows a system of continuous and formative evaluation, incorporated into the teaching/learning process. The wiki will help the students to develop a constant work that will take them to reach the proposed knowledge, and the skills and competences associated with the theory and problems parts.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory sessions	12	0.48	2, 3, 17, 4, 5, 6, 11, 9, 13, 18, 20, 21, 24, 22
Problems classes	10	0.4	1, 2, 7, 17, 4, 6, 11, 9, 14, 13, 20, 24, 23
Theory classes	26	1.04	2, 17, 6, 11, 9, 8, 12, 13, 15, 19, 20
Type: Supervised			

Tutored jobs and wiki queries	8	0.32	2, 17, 4, 6, 11, 13, 16, 20, 22
Type: Autonomous			
Laboratory preparation and autonomous work	26	1.04	1, 2, 3, 7, 17, 4, 5, 6, 10, 11, 18, 21, 24, 23
Preparation of the virtual portfolio (wiki) of the course	30	1.2	1, 2, 3, 17, 4, 6, 10, 11, 9, 13, 16, 18, 20, 21, 24, 23
Study and preparation of the assesment tests	28	1.12	2, 7, 17, 6, 10, 9, 13, 18, 20, 23

Assessment

Scheduled evaluation process and activities

The final grade of the subject, which includes assessment on the acquisition of knowledge, skills and competences, we will calculate by weighting:

- In 30% the qualification of the work done in the portfolio (wiki). The minimum grade required for this part is 5 out of 10.
  If a student passes the validation of knowledge tests but does not reach the minimum of work in the portfolio (wiki), this part can be recovered before the closing date of the minutes.
- In 30% the validation qualification of knowledge. The minimum grade required for this part is 5 out of 10. To carry out the validation of knowledge, two partial tests will be done during the course (a partial test to evaluate part I of the subject and another partial test to evaluate part II of the subject) and a final exam (which will evaluate both parts). If the student takes more than a 4 in one of the two parts in the partial tests, it should not be evaluated again of this part in the final exam (the note for this part will be that of the partial). The validation note will finally be the average of the marks obtained in the two parts. In order to make the average, the student must have obtained more than 4 in the theoretical exam of each part (either partial or in the corresponding part of the end). In case a student gets more than 4 in the two partial tests, but the average is less than 5, the final exam of the part with a grade lower than 5 must be presented (in case both parts are less than 5, the student can decide if he wants to take the final exam of the two parties or only of 1 of them).
- In 15% the qualification of the work done to the activities in class. No minimum grade is required for this part.
- In 25% the qualification of the laboratory sessions. The minimum grade required for this part is 5 out of 10.
  If a student does not achieve the minimum qualification of the laboratory sessions, he/she will be able to recover this part before the closing date of the minutes.

A minimum final grade of 5 is required to pass the course.

When a student does not pass any of the parts that require a minimum mark, the average will be calculated with the marks obtained. If this average is equal to or less than 4.9, the final mark will be this average, whereas if it is greater than 4.9 the final mark will be 4.9 (S).

The evaluation mechanisms used in the subject are described in more detail below.

Programming evaluation activities

The dates for continuous evaluation and submission of papers will be published on the first day of the subject in the virtual campus (and/or wiki of the subject) and may be subject to possible changes in programming for reasons of adaptation to possible incidents. Always be informed on the virtual campus (and/or wiki of the subject) about these changes as it is understood that this is the usual platform for exchange of information between teachers and students.

The following evaluation activities are foreseen:

- Portfolio: weekly

- Activities in class: weekly
- Internship: 4 sessions during the course, day and time depending on the laboratory group
- Validation test of laboratory practices 1 and 2, once the sessions are finished
- Partial exams of theory of parts I and II of the subject: around weeks 10 and 15
- Final theory exam

Recovery process

The student can apply for recovery whenever he has submitted to a set of activities that represent at least two thirds of the total grade of the subject.

The recovery mechanisms will focus on the activities 1) Portfolio, 2) Validation of Knowledge, 3) Laboratory sessions. In the event that a student has not approved any, or all of these parts, before the date of the final exam, you can retrieve this date by a written test (cases 2 and 3), making a second delivery of the laboratory work (case 3) or presenting the Portfolio to the Wiki before that date (case 1). In case 1, if the student recovers the Portfolio part, he will obtain an apt or not apt. If you get apt, you will have a 5 as a maximum grade. If you get unfit, you will have the grade previously obtained in this part.

Procedure to review the ratings

For each evaluation activity, a place, date and time of revision in which the student can review the activity with the teacher will be indicated. In this context, claims may be made on the activity grade, which will be evaluated by the faculty responsible for the subject. If not specified otherwise, if the student does not appear in this revision, this activity will not be reviewed later.

Special qualifications

Students who do not do anywork in the laboratory, donot submit to any of the partial or final written theory, and have a grade below 5 in the portfolio, it will be considered that there is not enough evidence of evaluation, and the note final will be "not evaluable". The rest ofthe students who have not passed the course will have a "Suspense" grade with the grade obtained in the subject. Those students qualified as having failed due to not having reached the minimum mark in any of the evaluation tests, will have as a grade the grade obtained in the evaluation test that has not been able to obtain the minimum required (always taking the minimum grade in the case that the minimum is not obtained in several tests).

Enrollment: To award a grade of honor registration is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.00. You can grant up to 5% of MH of the total number of students enrolled.

Irregularities by student parts, copy and plagiarism

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academic regulations, any irregularities committed by the student that could lead to a variation of the grade of an evaluation act will be scored with a zero. Therefore, copying or allowing to copy a laboratory work or any other evaluation activity will involve suspending with a zero, and if it is necessary to pass it to pass, the whole subject will be suspended. The evaluation activities qualified in this way and by this procedure will not be recoverable, and therefore the subject will be suspended directly without the opportunity to recover it in the same academic year.

Evaluation of repeating students

Repeatable students can validate the theory part ofthe subject. The way to calculate the final grade will be the same as the one mentioned above, taking the note of the portfolio, activities in class and exam of the theory part validate.

The repeating students will also be able to validate the laboratory work separately. The way to calculate the final grade will be the same as the one mentioned above, taking the note of the laboratory practice (or practices) that has been validated.

Evaluation criteria

The evaluation will be continuous and formative, based on a virtual portfolio prepared on a wiki, where students will accumulate the evidences of their learning. We will value the constant, collaborative and quality work in the subject. We will value the attainment of knowledge and skills based on the content of the portfolio and the laboratory development reports. The way in which the portfolio has been worked on, perfectly deductible from the activity records of the wiki, will help us assess the achievement of the competences.

Activities and instruments that will be used to evaluate

General organization

The first step is to divide the class group into a series of work teams, quite numerous to allow a dynamic of collaboration between them, and sufficiently small to allow the participation of all members. Each team is given access to a wiki.

The starting wiki that we provide the teams is not empty, but has a predefined web page structure, which the students must fill with the evidences of their learning process.

This template aims to guide, not force, the student in the organization of content.

Some pages are mandatory and others are optional. At the same time, we think of an open space in which students are not limited to the proposed content, but can create their own web pages, with unintended input content.

The use of the wiki allows students to learn to work autonomously as a team and coordinate. The wiki on which students must work is organized in evidence (or content) evaluable. The evidences that will be used in the wiki of this subject are the ones listed below. In addition to these, students can contribute others that will also be taken into account in the evaluation. With this we aim to awaken the student's creativity and allow their own learning objectives to be chosen.

One of the aspects that we consider key in this method of evaluation and learning is the feedback that can be between teacher and students and between the students themselves. If the participation of the students shows that they have not assimilated a concept well, the teacher or his classmates can add a clarification in the same wiki. In no case wrong to the wiki implies having a bad note, not even in the problems! Quite the opposite. Participation, mistakes and corrections will be key elements to guide learning. To reinforce the monitoring of the teams, tutoring will be scheduled at the corresponding times to analyze how it is going, find weak points, find solutions to specific problems, etc.

Evidence of learning included in the portfolio

For each subject of the subject students can participate in the preparationofthe following evidence, in pre-existing pages of the team's wiki:

Self-assessment issues

Students must demonstrate on a weekly basis that they have achieved the knowledge by answering the wiki the self-assessment questions raised by each theory section.

The work in the section on self-evaluation issues will be carried out jointly by all the members of the wiki team, at least 24 hours before the next problem session so that the other classmates have enough time to read it and have doubts, even for students who choose not to attend face-to-face sessions.

Each student must collaborate weekly and proportionally, responding to self-assessment questions. Each student must also read, understand and, if necessary, clarify or expand the answers of the classmates before the face-to-face session.

The objective is that once the face-to-face seminar session has been attended and the self-assessment issues have been updated, all team members understand all the self-assessment questions and the wording of the wiki is sufficiently comprehensible to be able to be used as material of study for all members.

Individual Activities

Some subjects have activities. Unless otherwise stated, these are individual activities and should be done before the next day of problems in the morning, even for students who choose not to attend face-to-face sessions.

Problems

The work in the problems section will be done individually and weekly.

The performance of the proportional part of the problems of the session is considered an assessable contribution.

In subjects where there are not enough problems for all the members of a team, the problems can be made in sub-teams of 2 or 3 members.

It is an evidence, to work the entire wiki team. For each list of problems delivered by the teacher, you must follow the next cycle, in a period of two weeks:

- Each student proposes a solution for 1 - 2 problems on the list.
- The rest of the students of the team make comments to the proposed solutions. In a problem session, we collectively discuss the problems on the list.
- Each student, based on the comments received from classmates and in the session, proposes the final solutions for their 1 or 2 problems.

Individual Extensions

Throughout the course there is an individual and mandatory extension of somesubject of the subject (commented or not to the face-to-face sessions).

Each student can make up to three additional optional extensions to improve the wiki grade.

Each extension must follow the following script:

- Make a short introduction of the selected theme (maximum 2000 characters)
- Put a scheme or figure
- Search, reference correctly and comment 10 links to websites where to find information on the subject. For each link it will be necessary to put:
    - URL (direct link to the page in question)
    - Date of the last query on the page
    - Title (if you have one), author/owner (if any), and date of creation of the page (if it is published).
    - Language in which it is written. Brief description of what can be found.
    - Scoring: personal assessment (from 1: weak to 5: very good).
- Conclusion (maximum 1000 characters)

In addition to these evidences, each team is free to create other pages, according to their interests and needs. At all times the teams are encouraged to add the elements they consider appropriate and that demonstrate theirlearning or their ability to use the knowledge or skills acquired.

Class activities

These are activities that are carried out within the theory and problem sessions, on a weekly basis.

As they are face-to-face activities, they do not have a mandatory nature (you do not have to do them to pass the subject).

Examples of these activities can be: a comment about a past documentary in class, the description of a theatrical activity done in class, a short and brief test of two questions about the theory session or problems just done in class.

Laboratory reports

The laboratory sessions are compulsory attendance and require the preparation of a previous report in which it is proven to have prepared each session. The projects developed in these sessions must be documented through development reports that must be submitted. These reports should include the main aspects of the design and the most significant issues of the implementation. Along with the information on the internship projects, a report template is also provided, which includes the basic questions that must be covered. With the writing of this report the students justify their development decisions and analyze the results obtained.

Knowledge validation tests

Knowledgevalidation tests are individual written tests that aim to validate if each student has achieved minimum knowledge and skills of the subject. These exams are motivated by the high importance that is given to a correct achievement of the knowledge and skills of the subjects in the engineering environment where we move. Knowledge tests are mandatory for everyone.

Indicators that will be used to rate the learning achieved

In the evidences included in the wiki, the indicators that we will use will be the individual constancy in the work, the cooperation between the members of each team, the quality of the work done and the degree of participation in the set of evidences. Quality indicators are the correct use of the technical terms, the correct writing of the paragraphs and the own elaboration of the material citing the used sources (that is to say, literally copying a text of a page in Internet is considered of null quality). We will value constancy in the sense that we believe that small frequent interventions are better than large interventions very spaced over time. At the same time, we think that the model of frequent small interventions favors cooperation among the members of the team, which we will also value positively. We will value that the pages are built and reviewed little by little between several people (at the opposite end, a page built from a word processor for a person and loaded as an attachment seems to us a model of zero cooperation). We will value that the resolutions of the problems are well argued and corrected in your case. We will value the fact that each student has participated a minimum number of times in each evidence. In the activitiesin class we will value the participation of the students and the reports ordocuments delivered. In the laboratory partwe will use as indicators thepreparation (previous reports) and the active participation in the laboratory sessions and the quality in the elaboration of the complete development reports. In the validation of knowledge tests, the main indication will be the degree of correctness of the answers to the questions raised.

Details about the laboratory

The laboratory sessions consist in the accomplishment of a series of works with which they try to reach knowledge and abilities seen in theory or totally new. It is considered equally important to have worked throughout the development of the laboratory, as having understood and learned the knowledge to them.

In the development of the subject, two projects will be carried out in the fields of:

- Creation of a dynamic web-site (2 weeks x 2 hours)
- Security (2 weeks x 2 hours)

The specific details on the organization of the laboratories (groups, calendar, weighting, ...) and on their follow-up (reports, attendance requirements, policy on originality of the code, ...) can be downloaded from the virtual campus.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessment of the development of the virtual portfolio (wiki)	30% The minimum grade required for this part is 5 out of 10	1	0.04	2, 17, 4, 6, 11, 9, 13, 16, 18, 20, 24, 23, 22
Class activities	15% No minimum grade is required for this part	2	0.08	2, 7, 17, 4, 6, 10, 11, 9, 8, 12, 14, 13, 15, 18, 19, 20, 24, 23

Follow-up of the laboratory sessions	25% The minimum grade required for this part is 5 out of 10	3	0.12	1, 2, 3, 7, 17, 4, 5, 6, 11, 9, 8, 16, 18, 21, 24, 22
Knowledge validation tests	30% The minimum grade required for this part is 5 out of 10	4	0.16	2, 17, 4, 6, 11, 9, 12, 13, 15, 18, 20

Bibliography

Basic bibliography

- Business Data Communications, 7e, William Stallings and Tom Case, Prentice Hall September 2012 ©

Supplementary bibliography

- Computer Networking: A Top Down Approach, 7e, Jim Kurose and Keith Ross, Addison-Wesley, May 2016 ©