Telematic Applications

Academic Year: (2024 / 2025) **Review date: 17-01-2025**

Department assigned to the subject: Telematic Engineering Department

Coordinating teacher: DIAZ SANCHEZ, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The subject "Statistics I" and have clear knowledge on calculation as means, variance, stb deviation and probability models.

The subject "Access Networks and Shared Media" and have clear knowledge on local networks, Ethernet (802.3) and Wireless LAN (IEEE 802.11) and their architecture; last mile access networks and the basis of TCP/IP stack.

The subject "Communications Networks and Services" and have clear knowledge on local network and internet architecture, IP protocol IP, ICMP and routing.

The subject "Systems Architecture"and have clear knowledge on programming in C and Java, data structures, debuggers (memory leak detection and program optimization), processes and threads and concurrency.

LEARNING OUTCOMES

CB1: Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2: Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1: Ability to write, develop and sign projects in the area of telecommunications engineering aimed at the design, development and utilization of telecommunications and electronic networks, services and applications, in accordance with the competences acquired in the degree program, as set out in Section 5 of OM CIN 352/2009.
ECRT1: Ability to learn and acquire autonomously the requisite new knowledge for the design, development and utilization of telecommunication systems and services.
ECRT13: Ability to differentiate the concepts of network access and transport, circuit switching and packet switching networks, fixed and mobile networks as well as systems and applications of distributed networks, voice services, audio, data, video and interactive services and multimedia.
ETEGITT4: Ability to construct, develop and manage telecommunication networks, services, processes and applications, such as capture, transport, representation, processing, storage, and multimedia information presentation and management systems, from the point of view of telematics services.
ETEGITT7: Ability to program network and distributed telematics services applications.
ETEGITT9: Ability to create, codify, manage, disseminate and distribute multimedia content, in accordance with criteria of usability, accessibility of audiovisual services, diffusion and interactivity.
RA1: Knowledge and understanding of the general fundamentals of engineering, scientific and mathematical principles, as well as those of their branch or specialty, including some knowledge at the forefront of their field.
RA3: Design. Graduates will have the ability to make engineering designs according to their level of knowledge and understanding, working as a team. Design encompasses devices, processes, methods and objects, and specifications that are broader than strictly technical, including social awareness, health and safety, environmental and commercial considerations
RA4: Research. Graduates will be able to use appropriate methods to carry out detailed research and

studies of technical aspects, commensurate with their level of knowledge. The research involves bibliographic searches, design and execution of experiments, interpretation of data, selection of the best proposal and computer simulation. May require consultation of databases, standards and security procedures.
RA5: Applications. Graduates will have the ability to apply their knowledge and understanding to solve problems, conduct research, and design engineering devices or processes. These skills include knowledge, use and limitations of materials, computer models, process engineering, equipment, practical work, technical literature and information sources. They must be aware of all the implications of engineering practice: ethical, environmental, commercial and industrial.
RA6: Generic competences. Graduates will have the generic skills necessary for engineering practice, and which are widely applicable. First, to work effectively, both individually and as a team, as well as to communicate effectively. In addition, demonstrate awareness of the responsibility of engineering practice, social and environmental impact, and commitment to professional ethics, responsibility and standards of engineering practice. They must also have knowledge of business and project management practices, as well as risk management and control, and understand their limitations. Finally, have the capacity for continuous learning.

OBJECTIVES

This course introduces the basic principles of the higher layers of communications networks: the transport layer and the application layer. Since the deployment of networks today is done in the context of Internet, this course will emphasize on the importance of end to end design, and the desirability of introducing other architectural elements beyond the traditional client-server.
The course requires the underlying levels (physical, link and network), and the important concepts introduced in them, to present the contributions in the higher levels in terms of congestion control, flow control, reliability of the communication, etc.. In addition, real applications and services wil be used to comprehensively demonstrate the incorporations of requirements into the design of protocols. To achieve this objective, the student must acquire certain knowledge, and exercise some abilities.

In relation to the objectives of the degree, this course contributes to the following:
- Ability to apply knowledge of mathematics, statistics, science, telecommunications technology, and engineering
- Ability to design and conduct experiments and analyze and interpret data
- Ability to identify, formulate, and solve engineering problems
- Knowledge of contemporary issues
- Ability to use techniques, skills and modern engineering tools necessary for the practice of engineering

At the end of the course the student will be able to:
- Understand the need, functions, levels and types of transport
- Understand advanced aspects of the Internet transport layer, and in particular TCP: algorithms, flow control, congestion control, timers, TCP challenges and alternatives.
- Understand advanced aspects of the Internet name service.
- Understand advanced aspects of popular Internet services, such as SMTP, HTTP, etc..

In terms of specific skills, at the end of the course, students will be able to:
- Perform and interpret detailed trace captures of different transport layer protocols and application.
- Calculate network requirements from assumptions regarding user populations and applications.
- Design new applications, services, and protocols for the Internet. Evaluate applications in connection with the use of the network: throughput, reliability, etc.

In terms of general abilities or skills during the course work:
- Ability to access and understand technical literature in both English and Castilian.
- Contact with technologies widely used in business.

DESCRIPTION OF CONTENTS: PROGRAMME

The objective of this course is to show advanced aspects of the transport layer in Internet and study in depth the application level in the communication architecture. To this end, we present in detail the various services offered on the Internet, such as email, file transfer, remote terminal, web and others. For each of these services we present the basics of its design and the protocols involved. The course program is as follows:

1. Advanced aspects of transport protocols
    - Introduction to TCP
    - Connection establishment and close. State Diagram
    - Interactive and bulk traffic. TCP algorithms: Nagle, slow start, congestion control, fast recovery / fast retransmit, and so on.
    - TCP timers: retransmission, persistence and keep-alive. Calculation and considerations
    - Other transport protocols: SCTP
2. Domain Name Server: DNS
3. Classical protocols: Study the design of classical protocols as telnet, rlogin, FTP or TFTP
4. Email: Encoding and formatting of emails (RFC 822, MIME), delivery protocols (SMTP) and final delivery protocols (POP as IMAP)
5. Web: HTTP and related protocols

Lab sessions (guided) will cover the following topics (note every item may span to several sessions)
1. Sockets programming (in C/Java): tools for accessing and using the socket API and notions about concurrency with sockets
2. Servers covering non concurrent and concurrent servers
3. Domain Name Service (DNS)
4. Email service
5. HTTP

Lab sessions (for mandatory assignment)
It is possible that up to 4 sessions will be devoted to the preparation of a mandatory assignment (in with teachers will assist and recommend in your development process or to answer technical questions).

LEARNING ACTIVITIES AND METHODOLOGY

The course will use three types of activities: classes of theory, problems and laboratory assignments.

Theory classes use traditional blackboard, transparencies, videos, etc. This traditional lectures introduce and illustrate the concepts of the course. Besides the theory, practical exercises are used to complement the explanations of theoretical concepts.

Problems activities are focused on applied problems and help to improve students' understanding of the theoretical concepts in a more applied way. They will help the students to self-evaluate their knowledge on the subject. This activities will provide students of high autonomy, providing access to problem statements and solutions gradually.

Problems activities include the sharing of individual solutions and joint correction, which should serve to consolidate knowledge and develop the capacity to analyze and communicate relevant information to solve problems. Besides sharing to promote the exchange of critical views both between teacher and students and between students.

The practical activities will be conducted in the laboratory and consist of well-defined experiments and designs. Lab assignments will offer the students a complementary point of view and provide them with valuable experience. Practices will encourage teamwork and project based learning.

ASSESSMENT SYSTEM

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

ASSESSMENT ACTIVITIES

Evaluation activities are now described in detail. Their weight in the overall grade is specified later when the assessments (continuous, ordinary, and extraordinary) to which each one applies are defined.

*Theoretical Evaluation:
- Partial Evaluation (E_1) [15%]: Covers Transport Protocols and Name Service. It will take place after finishing those contents (according to the schedule). It will contain a test on Transport Protocols and Name Service (where incorrect answers may subtract 1/3) and/or theoretical questions about the content [30% of the total exam]. Also, theoretical and practical problems (covering concepts explained in theoretical sessions and in laboratory sessions on Transport Protocols and Name Service) (70% of the total exam).

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

- Final Evaluation (E_2) [35%]: It will take place as scheduled by the university on the final exam day. It covers the entire subject as follows: It will contain a test on Mail Service and Web Service (where incorrect answers may subtract 1/3) and/or theoretical questions about the indicated content [30% of the total exam]. Also, theoretical and practical problems (covering concepts explained in theoretical sessions and in laboratory sessions on ALL the content of the subject) (70% of the total exam).
- E_ORD Ordinary exam (for those not following continuous assessment) with theory (test) and practical problems covering all the content of the subject.
- E_EXT Extraordinary exam (for those who did not pass continuous or ordinary evaluation) with theory (test) and practical problems covering all the content of the subject.

Laboratory Evaluation:
- Guided laboratory evaluation (PG1 and PG2): These tasks will be performed by students following a script with the assistance of teachers during the trimester.
They will be evaluated through written exams conducted in the laboratory (PG1 and PG2). The student will have a computer for this purpose. The PG1 exam [25%] will be conducted during the course in continuous evaluation, the PG2 exam [25%] will be conducted on the final exam day after the E_2 exam.
- PG_ORD Ordinary exam (for those not following continuous assessment) of laboratories covering all the content of the subject.
- PG_EXT Extraordinary exam (for those who did not pass continuous or ordinary evaluation) of laboratories covering all the content of the subject.

**TYPES OF EVALUATION:

*CONTINUOUS EVALUATION (100%)
E_1, PG1, E_2, and PG2 must be completed. Theory (average of E_1 and E_2) and laboratory (average of PG1 and PG2) must be passed separately to pass the subject. Teachers may establish minimum grades based on the course's progress. It is MANDATORY to attend all tests to remain in continuous evaluation.
The final grade will be calculated as follows: (E_1*0.15+E2*0.35)+(PG1*0.25+PG2*0.25).

*ORDINARY EVALUATION (without continuous - 60%)
In case of not meeting the continuous evaluation or by student's desire (which must be notified to the teachers before the final exam), an ordinary final exam will be held on 60% of the grade. The student must pass E_ORD (40%) (theory) and PG_ORD (20%) (laboratory evaluation) on the final exam day.
The final grade will be calculated as follows: (E_ORD *0.40+PG_ORD*0.20).

*EXTRAORDINARY EVALUATION (100%)
Depends on whether the student followed continuous evaluation or not (the E_EXT and PG_EXT exams are the same in any case, but if the student did continuous evaluation, both grades will be calculated and the one that benefits the student more will be given):
- EXTRAORDINARY if the student followed continuous evaluation (100%): Must take E_EXT and PG_EXT on the final exam day. Grades from the continuous evaluation passed during the trimester will be added as follows (E_1*0.15+E_EXT *0.35)+(PG1*0.25+PG_EXT*0.25). The need to pass theory and laboratory separately is maintained.
- EXTRAORDINARY (100%): Must take a written exam containing E_EXT theory and pass a PG_EXT laboratory exam on the final exam day. The grade is calculated as (E_EXT*0.65+PG_EXT*0.35).

BASIC BIBLIOGRAPHY

- Forouzan, Behrouz A. TCP/IP protocol suite, McGraw-Hill Higher Education, 2006

- James F. Kurose Computer Networking, Pearson, 2010

- Stevens, W. R. TCP/IP Illustrated Vol. 1 The protocols, Prentice Hall, 1994

ADDITIONAL BIBLIOGRAPHY

- Ilya Grigorik High Performance Browser Networking. , O'Reilly, 2013

BASIC ELECTRONIC RESOURCES

- Ilya Grigorik . High Performance Browser Networking: https://hpbn.co/