Telematic Applications

Academic Year: (2021 / 2022) **Review date: 04-06-2021**

Department assigned to the subject: Department of Telematic Engineering

Coordinating teacher: CAMPO VAZQUEZ, MARIA CELESTE

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Systems Programming
Access Networks and Shared Media
Communications Networks and Services
Systems Architecture I

OBJECTIVES

The goal of this subject is to study the end-to-end protocols that support Internet applications, i.e., the advanced aspects of transport layer protocols, and the main application layer protocols: DNS, e-mail, file transfer, remote terminal, web, etc.

The specific objectives are the following:
- Understanding the advanced functions of the transport layer protocols (e.g., the flow control and congestion control mechanisms in TCP).
- Knowing the basic principles of cryptography and security, symmetric and public key algorithms, digital signature, message digest, public key infrastructure, security in transport layer (TLS) and application layer.
- Knowing the architecture, message format, and how the different application layer protocols studied in the subject work: name service, file transfer, remote terminal, e-mail, web, and time protocol.
- Being able to program applications using sockets.
- Solving practical cases of use of the different application layer protocols in different computer networks.

The basic competences are:
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.

The general competences are:
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.

The specific competences are:
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.
ETEGT4: Ability to describe, program, validate and optimize communication protocols and interfaces at different levels in a network architecture.
ETEGT6: Ability to design network architectures and telematics services.
ETEGT7: Ability to program telematics services and applications in network and distributed systems.

The learning outcomes are:
RA1: Knowledge and Understanding. 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.

Link to document

DESCRIPTION OF CONTENTS: PROGRAMME

The content of the program will be the following:
1. Advanced aspects of transport protocols
- Review of the legacy transport protocols (TCP, UDP).
- New variants of TCP.
- QUIC.
- Programming applications using sockets.
2. Security in application and transport layer protocols.
- Basic principles: Symmetric Key Cryptography, Public Key Encryption, Message Integrity and Digital Signatures.
- Securing TCP Connections (TLS) and application.
3. Domain name servers (DNS):
- DNS infrastructure.
- DNS protocol.
- Advanced aspects of DNS (DoT, DoH).
4. Classic protocols:
- Remote login: telnet, rlogin and ssh.
- File transfer: FTP and TFTP.
6. E-mail:
- Formats: RFC 822, MIME and S/MIME.
- Sending protocols: SMTP and ESMTP.
- Final delivery protocols: POP and IMAP
7. Web: HTTP.
- HTTP/1.0.
- HTTP/1.1.
- Content Distribution Networks
- HTTP/2 and HTTP/3.
8. Introduction to IoT protocols.
- CoAP.
- MQTT.

LEARNING ACTIVITIES AND METHODOLOGY

The learning activities and methodology are:
- Theoretical classes. The teacher will present the main concepts. Participation of the students, interactions, and discussions about the presented problems will be promoted.
- Practical classes. The teacher will raise some problems that will allow the students to propose and analyze some solutions.
- Laboratory sessions. Sessions in which the student will have to solve some simple problems that illustrate the behavior of the different protocols studied in the subject, and a programming practice

consisting in the implementation of a protocol.
- Tutoring sessions: Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.

ASSESSMENT SYSTEM

The continuous assessment will based on:
- Practices and exercises: 70%. Practices and exercises made in the lab will be evaluated.
* The students will develop a project that will consist on the implementation of a client and/or a server following the specification of an application layer protocol, in which the knowledge and capacities acquired in the course will have to be applied. This protocol will complement some of the ones studied in the theoretical lectures. It will be based on an RFC-like specification. The mark obtained in this part will be the 10% of the final mark.
* Guided practical assignments about different protocols. The evaluation will be carried out through tests in the laboratory of which a written result will be delivered. The mark obtained in this part will be the 60% of the final mark.

The end-of-term exam: 30%. It will consist on a written exam to assess both the theoretical and the practical concepts acquired by the student. It will be necessary to obtain at least 4.0 points over 10 in this part to pass the subject.

As an alternative to the continuous assessment, there will be a final exam with a total value of 60% in the ordinary exam, and of 100% in the extraordinary exam, for the students that will decide not to integrate in the previous scheme of continuous evaluation.

% end-of-term-examination:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

BASIC BIBLIOGRAPHY

- - RFCs of the protocols (see references in the course material)., -.

- Barry Pollard. HTTP/2 in Action, Manning Publications, 2019

- Ilya Grigorik "High Performance Browser Networking" (available in https://hpbn.co/), O'Reilly, 2013/2015

- Kevin R. Fall; W. Richard Stevens "TCP/IP Illustrated, Volume 1: The Protocols, 2/E", Addison-Wesley Professional, 2011

- Kurose, James F.; Ross, Keith W. "Computer Networking: A Top-Down Approach 7ed", Pearson Education, 2016

- W.R. Stevens "TCP/IP Illustrated Vol.1 The protocols", Prentice Hall, 1993

- Ying-Dar Lin, Ren-Hung Hwang, Fred Baker "Computer networks: an open source approach", McGraw-Hill, 2012

ADDITIONAL BIBLIOGRAPHY

- Andrew S. Tanenbaum "Computer Networks" 5ed, Prentice Hall International, 2011

- B. Forouzan "TCP/IP Protocol Suite" 4ed, McGraw-Hill, 2010

- Dordal, Peter L An Introduction to Computer Networks (http://intronetworks.cs.luc.edu), Department of Computer Science. Loyola University Chicago, 2019

BASIC ELECTRONIC RESOURCES

- IETF . RFCs: https://www.ietf.org/standards/rfcs/