

Academic Year: ( 2023 / 2024 )

Review date: 28-04-2023

Department assigned to the subject: Telematic Engineering Department

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.

## 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 be 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 in 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 in 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.

<b>% end-of-term-examination:</b>	30
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	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/>

