Universidad de Alcalá

TEACHING GUIDE

Computer networks

Degree in
Computer Engineering (GIC)
Computer Science Engineering (GII)
Computer Science Engineering and Business Management and Administration (GII-ADE)

Universidad de Alcalá

Academic Year 2025/2026

2nd Year - 2nd Semester (GIC+GII)

3rd Year - 2nd Semester (GII-ADE)

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Computer networks**
Code:	**780017 (GIC+GII+GII-ADE)**
Degree in:	**Computer Engineering (GIC)** **Computer Science Engineering (GII)** **Computer Science Engineering and Business Management and Administration (GII-ADE)**
Department and area:	**Automática** **Telematics Engineering**
Type:	**Compulsory (GIC+GII+GII-ADE)**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year - 2nd Semester (GIC+GII)** **3rd Year - 2nd Semester (GII-ADE)**
Teachers:	Coordinador: Dr. Miguel Ángel López Carmona (miguelangel.lopez@uah.es)
Tutoring schedule:	To be confirmed at the beginning of the course.
Language:	English

1. COURSE SUMMARY

This course, together with “Network Architectures”, comprises the mandatory subject of “Telematics Fundamentals”. The subject contents encompass an introduction to telematics, the main elements of communication networks, and the necessary knowledge to understand how they work, to analyze their performance, to design data networks, and to make decisions about their deployment.

The learning process follows a top-down model, starting with the applications the students are already familiar with, discussing the needs of these applications must work properly in a distributed environment. In this way, w ego down the different layers of the protocol stack until we reach the link and physical layers.

In particular, this course continues the study started in “Network Architectures I” (basic concepts and the application and transport layers) and finishes the top-down review of the classical protocol stack covering the network and link layers. Later, the course addresses the study of other technologies, not tied to a particular protocol layer, such as wireless and mobile networks, network security, and network management.

In summary, the main content blocks we cover in this course are:

- Network interconnection. Addressing. Routing algorithms and protocols.
- Datalink. Error control.
- Medium Access techniques. Local area networks. Switched networks. VLAN.
- Wireless networks. Mobile networks.
- Network security.
- Network management.

The course contents include activities of network monitoring, using traffic and protocol analyzers, and network emulators.

It is recommended to have passed the course “Network Architectures” before taking this course.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following basic, generic and cross curricular skills:

en_CG3 - Ability to design, develop, evaluate and ensure accessibility, ergonomics, usability and security of computer systems, services and applications, as well as the information they manage.

en_CG6 - Ability to conceive and develop centralized or distributed computer systems or architectures integrating hardware, software and networks in accordance with the knowledge acquired as set out in section 5, annex 2, of resolution BOEA-2009-12977.

en_CG8 - Knowledge of the basic subjects and technologies, which enable them to learn and develop new methods and technologies, as well as those that provide them with great versatility to adapt to new situations.

en_CG9 - Ability to solve problems with initiative, decision making, autonomy and creativity. Ability to know how to communicate and transmit the knowledge, skills and abilities of the profession of Computer Engineering Engineer.

en_CG10 - Knowledge to perform measurements, calculations, assessments, appraisals, appraisals, studies, reports, task planning and other similar computer work, in accordance with the

knowledge acquired as set out in section 5, annex 2, of BOE resolution -A-2009-12977.

en_CB1 - That students have demonstrated to possess and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

en_CB2 - That the students know how to apply their knowledge to their work or vocation in a professional manner and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

en_CB3 - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

en_CB4 - That students can transmit information, ideas, problems and solutions to both a specialized and non-specialized public.

en_CB5 - That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Specific Skills

This course contributes to acquire the following specific skills:

en_CI1 - Ability to design, develop, select and evaluate applications and computer systems, ensuring their reliability, safety and quality, in accordance with ethical principles and current legislation and regulations.

en_CI5 - Knowledge, administration and maintenance of computer systems, services and applications.

en_CI11 - Knowledge and application of the characteristics, functionalities and structure of Distributed Systems, Computer Networks and Internet and to design and implement applications based on them.

Learning Outcomes

After succeeding in this subject the students will be able to:

- **RA1.** Identify and explain the protocols and data formats used at the network layer on the Internet and at the link layer in wired and wireless local area networks, along with the mechanisms used to interconnect networks.
- **RA2.** Organize, leverage, and manage IP network addressing.
- **RA3.** Describe and apply the routing algorithms and techniques used in IP networks.
- **RA4.** Identify and describe the different medium access control techniques and explain the fundamentals of switched local area networks and VLANs.
- **RA5.** Identify problems and propose basic solutions regarding network security and network management.
- **RA6.** Teamwork in a collaborative way for the resolution of problems and to communicate in an effective way their knowledge, procedures, results, and ideas about it, both in writing and in oral

form.

3. CONTENTS

Contents Blocks	Total number of hour
Network layer: virtual circuits networks and datagram networks, IP and ICMP protocols. Routing protocols: OSPF y BGP. Addressing, DHCP protocol and NAT.	20 hours (5 weeks)
Link laker: link control; ARP; medium access control techniques; Ethernet; switches; VLAN; PPP protocol; wireless networks (WiFi and Bluetooth) and mobile networks.	16 hours (4 weeks)
Cryptography and network security. Network management.	12 hours (3 weeks)
Global review and integration exercises.	8 hours (2 weeks)

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	60 hours (56 hours on-site + 4 exams hours)
Number of hours of student work:	90
Total hours	150

4.2. Methodological strategies, teaching materials and resources

Theory sessions (large groups)	• Concept presentations and/or reviews. • Presentations, interactive activities, and other activities.
Clases Prácticas (en grupos reducidos)	• Practical concept presentation and/or review • Problem-solving. Case studies. • Practical lab sessions to strengthen previously presented concepts as well as to familiarize the student with IT and hardware tools that are useful to support the study of the subject and future professional performance (protocols analyzers, network simulators). • Presentations, interactive activities, and other activities.
Individual, group and online office hours	• Solving student questions • Support to autonomous learning
Autonomous student work	• Reading assignments. • Activities: exercises, information lookup, self-assessment work.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

In the ordinary call, students will undertake a continuous assessment process. This process includes lab assignments, activities in class, self-assessment quizzes, and two intermediate exams.

In exceptional circumstances, adequately documented, a student might be assessed by a **Single Final**

Exam.

Extraordinary Call

The Extraordinary Call will have a **similar exam** format to the one used for the Final Exam assessment in the Ordinary Call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria evaluate the degree of acquisition of the competencies described in Section 2 of this Syllabus. The following criteria are described:

CE1: The student has acquired technical knowledge regarding the network layer and link layer standards used in the Internet and in wired/wireless local area networks, respectively, regarding data format, protocols, and network interconnection.

CE2: The student can leverage, organize, and manage IP addressing spaces for arbitrary network topology.

CE3: The student can compute shortest paths given a network topology using Distance Vector and Dijkstra algorithms, and to configure routing tables accordingly using a minimum number of entries.

CE4: The student can identify and describe the main medium access control techniques, and to solve basic medium access control exercises.

CE5: The student shows knowledge of the fundamentals of wireless LANs, switched LANs, and VLANs.

CE6: The student shows knowledge about the fundamentals of cryptography and network security techniques used to achieve confidentiality, authentication, and integrity in communication networks.

CE7: The student can explain the general problems and solutions related to network management.

CE8: The student shows skill to operate network simulation tools and protocol analyzers.

CE9: The student is able to work collaboratively to solve problems related to computer networks.

CE10: The student is able to communicate effectively their knowledge, procedures, results, and ideas in the context of the subject, both in writing and orally.

GRADING TOOLS

The following grading instruments will be applied to each of the assessment criteria:

1. **Lab Assessment Assignments (PL):** lab assignments with protocol analyzers and network emulators. The laboratory assignments must be done during the corresponding session. Likewise, the delivery of the practical will be done during the same session.
2. **Self-Assessment Quizzes (E):** online quizzes and in-class activities and quizzes.
3. **Intermediate Assessment Exams (PEI):** involving practical exercises and demonstration of knowledge about theoretical concepts.
4. **Final Assessment Exam (PEF):** involving practical exercises and demonstration of knowledge about theoretical concepts. It will be similar in structure to the PEIs, but covering the whole contents of the course, while each PEI covers different contents.

GRADING CRITERIA

Here we quantify the grading criteria for the course.

Ordinary Call, Continuous Assessment

In the ordinary call with continuous assessment, we have the following relationship between assessment instruments and criteria.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG3, CG6, CG8, CG9, CG10, CI1, CI5, CI11, CB1, CB2, CB3, CB4, CB5, TRU1, TRU2, TRU3, TRU4, TRU5	RA1-6	CE1-3, CE5-6, CE8-10	PL, E	20%
CG3, CG6, CG8, CG9, CG10, CI1, CI5, CI11	RA1-6	CE1-10	E	15%
CG3, CG6, CG8, CG9, CG10, CI5, CI11, CB1, CB2, CB3, CB4, CB5, TRU1, TRU2, TRU3, TRU4	RA1-3, RA6	CE1-3, CE10	PEI1	30%
CG3, CG6, CG8, CG9, CG10, CI1, CI11, CB1, CB2, CB3, CB4, CB5, TRU1, TRU2, TRU3, TRU4	RA4-5, RA6	CE4-7, CE10	PEI2	35%

All quizzes, exams, and assignments are additive (there are no eliminatory tests). Students which, while undertaking the continuous assessment procedure, do not take any of the PEI and PEF, will have a “Not presented” grade in the ordinary call.

Ordinary Call, students without continuous assessment

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG3, CG6, CG8, CG9, CG10, CI1, CI5, CI11, CB1, CB2, CB3, CB4, CB5, TRU1, TRU2, TRU3, TRU4, TRU5	RA1-6	CE1-10	PEF	100%

Extraordinary call

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG3, CG6, CG8, CG9, CG10, CI1, CI5, CI11, CB1, CB2, CB3, CB4, CB5, TRU1, TRU2, TRU3, TRU4, TRU5	RA1-6	CE1-10	PEF	100%

All the students will take the PEF exam that covers the theoretical and practical contents of the subject. In the case of students subject to continuous assessment in the ordinary call, they will have the option of maintaining their laboratory grade with a weight of 20% on the total score.

The teaching-learning methodology and the evaluation process will be adjusted when necessary, with the guidance of the Diversity Support Unit, to apply curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Computer Networking: A Top-Down Approach" (7th Edition), J. Kurose & K.W. Ross. Pearson Education, 2017.

6.2. Additional Bibliography

- Data and Computer Communications (9th Edition), W. Stallings. Prentice Hall, 2010.
- Computer Networks (5th Edition), A.S. Tanenbaum. Prentice-Hall, 2010.
- Computer Networking and the Internet (5th Edition), F. Halsall, Addison Wesley, 2005.

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.