Universidad de Alcalá

TEACHING GUIDE

Networks Architecture

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 - 1st Semester (GIC+GII)

3rd Year - 1st Semester (GII-ADE)

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

TEACHING GUIDE

Course Name:	**Networks Architecture**
Code:	**780011 (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 - 1st Semester (GIC+GII)** **3rd Year - 1st Semester (GII-ADE)**
Teachers:	Enrique de la Hoz de la Hoz
Tutoring schedule:	To be confirmed at the beginning of the course
Language:	English

1. COURSE SUMMARY

Networks Architecture is a compulsory 6 ECTS course included in the first semester second year of the Degree in Computer Engineering and Degree in Computer Science Engineering.

The contents of this subject cover the introduction to telematics, the main components of communication networks, the required knowledge to analyze their operation, to carry out performance and efficiency calculations, and to make informed design and deployment decisions.

The learning process follows a top-down approach, starting with those applications that are already being used by students, considering the requirements of those applications to work properly in a distributed environment. Then, we will descend through the different layers of the Internet protocol stack until we arrive to the link layer and its relationship with the physical layer (in Communication Networks). The transport layer is the last layer studied in Network Architectures.

More concretely, the main topics that are studied in this course are: network elements (hosts, service model, access network and core network), physical media and multiplexing, switching paradigms (circuit switching vs. packet switching), network architectures (service model, network topologies and protocols), telematics services and applications and data transport.

In the first part of the course, the basic concepts that are essential to understand the operation of communication networks (such as: network elements, service model, protocol concept, basic features of physical transmission media that set up links and the concept of multiplexing) are presented.

The different network technologies are classified according to their topology (mesh, star, tree), their size (WAN, MAN, LAN), the type of service that they can offer, the distance to the final user (access, aggregation, core), the physical media of the link used by the final user (wireless, wired) and its main features (fixed, mobile). The most common access technologies nowadays are presented and the two main switching paradigms (circuit switching vs. packet switching) are discussed. The concepts of standardization and regulation are also introduced, identifying the main agents involved in both processes.

After this first overview, the study continues, focused on packet switching networks, following a top-down approach to classical protocol architectures applied to a widely extended technology like TCP/IP, analysing in depth:

- Distributed applications, application protocols and telematic services (web and domain name service).
- Reliable and non-reliable data transport. End to end flow and error control. Retransmission techniques. Congestion control.

The practical contents of the course include activities like monitoring devices and network software, with the most widely used technologies, like Internet or TCP/IP protocol stack. The use of traffic and protocols analysers is also studied, as well as programming assignments related to application and transport layers.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

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

en_CG2 - Ability to direct the activities object of the projects in the field of information technology

in accordance with the knowledge acquired in accordance with the provisions of section 5, annex 2, of resolution BOE-A-2009-12977.

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_CG5 - Ability to conceive, develop and maintain computer systems, services and applications using software engineering methods as an instrument for quality assurance, in accordance with the knowledge acquired as established in section 5, annex 2, of the resolution BOE-A-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_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_CI2 - Ability to plan, conceive, deploy and direct projects, services and computer systems in all areas, leading its implementation and continuous improvement and assessing its economic and social impact.

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.

en_CI13 - Knowledge and application of the necessary tools for storage, processing and access to Information Systems, including web-based ones.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

RA1: Identify the physical and logical components of the architecture of a data network.

RA2: Explain and understand the operation of switching techniques used in data networks.

RA3: Identify the main bodies responsible for standardization on the Internet.

RA4: Explain the concept of communications protocol.

RA5: Know the main stratified architecture models used in data networks (OSI reference model and TCP / IP architecture) and distinguish the functions of each of their levels.

RA6: Obtain performance parameters and delays in data networks.

RA7: Explain the structure and operation of a Client / Server model.

RA8: Analyse and explain the main protocols of the application layer, using computer tools.

RA9: Analyse and explain the main protocols of the transport layer of the TCP / IP architecture, using computer tools.

RA10: Develop a simple application of a telematic service using standard interfaces of network communication.

RA11: Investigate new aspects of networks autonomously using search and information management tools.

RA12: Cooperate in Teamwork to solve problems related to networks and effectively communicate knowledge, procedures, results, and ideas in this regard, both in writing and orally.

3. CONTENTS

Contents Blocks	Total number of hours
Unit 1. Computer networks: elements, protocols, switching options, delay, service models, layered architectures.	12 hours (3 weeks)
Unit 2. Application level protocols: distributed applications, C/S model, common protocols (HTTP, DNS), socket programming.	16 hours (4 weeks)
Unit 3. Transport layer: reliability, TCP, UDP, retransmission techniques, congestion control.	28 hours (7 weeks)

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	Class: 56 hours Evaluation: 4 hours **Total:** 60 hours
Number of hours of student work:	Class preparation, exercise preparation, autonomous learning, lab and quiz preparation, readings, final exam preparation **Total:** 90 hours
Total hours	150 hours

4.2. Methodological strategies, teaching materials and resources

Theory lectures (large groups)	• Concept presentation and/or review • Oral presentations and other activities
Practical lectures (reduced groups)	• Practical concept presentation and/or review • Problem solving • Practical lab sessions are aimed at reinforcing key concepts and providing experience with tools such as: APIs for distributed application development, office software, protocol analyzers, and network measurement tools. • Oral presentations and other activities • Teamwork activities
Tutoring and Consultancy (individual and groups, in-room, e-mail, etc.)	• Solving questions • Support to self-learning
Autonomous working	• Reading assignments • Activities: exercises, search for information, self-assessment quizzes

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 the student will be assessed by Continuous Assessment (EC) process, unless the final evaluation is granted to the student.

Extraordinary Call

The extraordinary call will consist of a similar quiz to that arising in the evaluation system by Final Exam.

5.2. EVALUATION

EVALUATION CRITERIA

Evaluation Criteria must address the extent of acquisition of skills by the student. For this purpose, the following are defined:

CE1. The student shows knowledge and understanding of the concepts specified in the blocks of contents section about Computer networks and protocols.

CE2. The student can solve practical problems related to the subject about performance and logic of protocols.

CE3. The student can properly use software analysis tools to work with the protocols used in the course.

CE4. The student is able to use a simple Applications Programming Interface to develop telematics applications

CE5. The student shows ability to work in teams during Small Group activities.

CE6. The student can work autonomously, searching, and properly managing information related to the contents of the subject.

GRADING TOOLS

Students have two calls to pass the course: ordinary and extraordinary calls.

Ordinary call

In the ordinary call, students have two paths to pass the course: continuous or final evaluation. Continuous evaluation is the default system, although those students who cannot follow this mechanism can request the EPS to take the final evaluation exam. Next, you can find the grading tools used in these two evaluations:

- Continuous Assessment

1. Partial Quiz Assessments (PEIx): 2 Partial Quiz Assessments (PEI1 and PEI2) consisting of questions about theoretical issues and the execution of one or more exercises. These partial exams assess three different units (Ux):

- U1: Introduction to communication networks and calculation of efficiency parameters in the context

of communications networks.
- U2: Analysis of the operation of application protocols in TCP/IP network architecture.
- U3: Analysis of the operation of transport protocols in TCP/IP network architecture.

PEI1 takes place at the end of the first half of the semester approximately, on a date that will be announced at the beginning of the course, and evaluates the first and second unit of the subject.

PEI2 takes place at the end of the quarter, on the official examination date, and evaluates the third unit of the subject.

Students who do not take any of the two partial tests (PEIx) will have a grade of Not Presented (NP) in the ordinary call.

2. Personal Work Tests (PS): Consisting on the assessment of the learning process of students by means or short test during the whole term.

3. Laboratory Tests (PL): Consisting of making small theoretical/practical tests and monitoring the work done in Small Group sessions. This will be done by the teacher during the whole term.

- Final evaluation:

This evaluation consists on one single exam (PEF), which will be held on the day assigned by the EPS Direction for the examination of the subject within the examination period, and based in written exposition or test about theoretical issues and the execution of one or more exercises which cover the whole content of the subject, including:

- Calculation of efficiency parameters in the context of communications networks.
- Analysis of the operation of the application and transport layer protocols of the TCP/IP architecture.

Extraordinary call

Those students who did not pass the ordinary call can take another exam, similar to the final evaluation exam of the ordinary call (PEF).

GRADING CRITERIA

Ordinary call, Continuous Assessment:

Students will take PEI1 and PEI2 exams, and the score obtained will be added to the ones of type PS and PL with the weights indicated in the table.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG2-CG5, CG8, CB1-CB4, CI2, CI5, CI11, CI13, TRU1, TRU3, TRU4	RA1-RA5, RA11	CE1, CE2, CE6	PS	15%
CG2-CG5, CG8, CB1-CB4, CI2, CI5, CI11, CI13, TRU1, TRU3, TRU4, TRU5	RA6-RA10, RA12	CE1-CE5	PL	15%
CG2, CG3, CG4, CG5, CG8, CB1-CB4, CI2, CI5, CI11, CI13, TRU1-TRU4	RA1-RA8, RA10, RA11	CE1-CE3, CE6	PEI1 (Unit 1 and 2, theory and practice)	30%
CG2-CG5, CG8, CB1-CB5, CI5, CI11, CI13, TRU1-TRU4	RA5, RA8, RA9, RA11	CE1-CE4, CE6	PEI2 (Unit 3, theory and practice)	40%

Those students that carry out at least to one of the qualification tests (PEI1 or PEI2), will be considered as presented on the Ordinary Call.

Ordinary call, Final Assessment:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA1-RA11	CE1-CE4, CE6	PEF (Units 1, 2 and 3 [Theory and practice)	100%

Extraordinary call:

In the Extraordinary Call for students under continuous assessment the relationship between continuous assessment criteria, evaluation instruments and criteria is as follows. Students will take the PEF exam and, if they have followed the continuous evaluation assessments, the scores of the PS and PL tests will be maintained with the weights indicated in the previous tables. Thus, the weight of PEF will be 70%.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG2-CG5, CG8, CB1-CB4, CI2, CI5, CI11, CI13, TRU1, TRU3, TRU4	RA1-RA5, RA11	CE1, CE2, CE6	PS	15%
CG2-CG5, CG8, CB1-CB4, CI2, CI5, CI11, CI13, TRU1, TRU3, TRU4, TRU5	RA6-RA10, RA12	CE1-CE5	PL	15%
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA1-RA9, RA11	CE1-CE4, CE6	PEF (Units 1, 2 and 3 [Theory and practice)	70%

Those students who did not follow the continuous evaluation process during the ordinary call have to take a PEF that represents the 100% of the extraordinary call. This exam includes all the content explained during the course, including those evaluated in the PS and PL:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA1-RA11	CE1-CE4, CE6	PEF (Units 1, 2 and 3 [Theory and practice)	100%

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, International Edition, 2017.

6.2. Additional Bibliography

- Data and Computer Communications (9th International Ed.) W. Stalling. Prentice-Hall International, 2010.
- Computer Networks (5ª International Ed.) A.S. Tanenbaum. Prentice-Hall International, 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.