Universidad de Alcalá

TEACHING GUIDE

Programming

Degree in
Telecommunication Technologies Engineering (GITT)
Telecommunication Systems Engineering (GIST)
Telematics Engineering (GIT)
Electronic Communications Engineering (GIEC)

Universidad de Alcalá

Academic Year 2026/2027

1st Year - 2nd Semester (GITT+GIST+GIT+GIEC)

Approved by the EPS School Board on June 15th, 2026

TEACHING GUIDE

Course Name:	**Programming**
Code:	**350009 (GITT+GIST+GIT+GIEC)**
Degree in:	**Telecommunication Technologies Engineering (GITT)** **Telecommunication Systems Engineering (GIST)** **Telematics Engineering (GIT)** **Electronic Communications Engineering (GIEC)**
Department and area:	**Automática** **Systems Engineering and Automation**
Type:	**Compulsory (GITT+GIST+GIT+GIEC)**
ECTS Credits:	**6.0**
Year and semester:	**1st Year - 2nd Semester (GITT+GIST+GIT+GIEC)**
Teachers:	Miguel Ángel Sotelo Vázquez
Tutoring schedule:	Several timetables
Language:	English

1. COURSE SUMMARY

The subject “Programming” is an obligatory matter with six credits that is given in the 1st year, the second semester of the Degree in Engineering in Telecommunication Systems, Degree in Telecommunication Technologies, Degree in Communication Electronics and Degree in Telematics.

The fundamental target of the subject is the knowledge of the basic skills of computer programming. The language used will be “C” language, whose basic aspects have already been studied in the previous subject named “Informatic Systems” that is given in the first semester.

This subject is a direct continuation of the subject "Informatic Systems" taught during the first semester and includes the following main topics: pointers, functions, files, dynamic data structures and algorithms.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_TR2 - Knowledge of basic subjects and technologies that enables to learn new methods and technologies, as well as to provide versatility that allows adaptation to new situations.

en_TR3 - Aptitude to solve problems with initiative, decision making, creativity, and to communicate and to transmit knowledge, skills and workmanship, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.

en_TR5 - Easy to handle specifications, regulations and mandatory standards.

en_TR8 - Capacity of working in a multidisciplinary and multilingual team and of communicating, both in spoken and written language, knowledge, procedures, results and ideas related to telecommunications and electronics.

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.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CT2 - Ability to use telecommunications and computing aplications (ofimatics, data bases, advanced calculus, project management, visualization, etc) in order to support the exploration and development of nets, services and aplications of telecomunications and electronic.

en_CT3 - Ability to use computer tools to search bibliographic resources or information relating to telecommunications and electronics.

en_CT7 - Knowledge and use of the essentials of programming in networks, systems and services of telecommunication.

Learning Outcomes

When successfully finishing this course, the students will be able to:

RA1. Know and use computer programming.

RA2. Use pointers and implement functions in C language.

RA3. Create and use recursive functions.

RA4. Create and manipulate files.

RA5. Create and handle dynamic data structures.

RA6. Know and use some algorithms of common use.

RA7. Use computer tools for searching bibliographic resources and information.

3. CONTENTS

Contents Blocks	Total number of hours
Review of basic C languaje	4 hours of theory and 6 hours of laboratory
Pointers and Functions	12 hours of theory and 6 hours of laboratory
Files	6 hours of theory and 6 hours of laboratory
Dynamic data structures	6 hours of theory and 4 hours of laboratory
Algorithms	2 hours of theory

Week	Content
1st	• Review of basic C language. Review of fundamental concepts on pointers: typical errors, operations with pointers, memory storage. (4 hours)
2nd	• Pointers and arrays. Pointers to characters strings. Arrays of pointers. Pointers to pointers. Generic Pointers. Dynamic memory allocation. (4 hours)
3rd	• Passing parameters by reference. Passing arrays to functions. Passing pointers to functions. Pointers returned by a function. (2 hours) • Laboratory-1: Review of C languaje. Variables. Input/output. Flow control sentences. (2 hours)
4th	• Pointers to structures. Passing structures to functions by value and by reference. (2 hours) • Laboratory-2: Review of C language (II). Data comparation. Functions. (2 hours)
5th	• Arguments in the command line. (2 hours) • Laboratory-3: Review of pointers. (2 hours)
6th	• Recursivity. Recursive functions. (2 hours) • Laboratory-4: Pointers and arrays. Character strings. (2 hours)

7th	• Management of files in C. Opening and closing files. Errors and end of file detection. Deleting, renaming and copying files. (2 hours) • Laboratory-5: Pointers and structures. Enumerated types. (2 hours)
8th	• Reading and writing in text files. (2 hours) • Laboratory-6: Arguments in the command line. Recursivity. (2 hours)
9th	• Reading and writing in binary files. (2 hours) • Laboratory-7: PEL1 laboratory examination. (2 hours)
10th	• File access types. Sequential access and random access. (2 hours) • Laboratory-8: Text files. (2 hours)
11th	• Dynamic data structures: Simply linked linear lists. Basic operations: insertion, search, elimination and sorting. (2 hours) • Laboratory-9: Memory allocation and text files. (2 hours)
12th	• Dynamic data structures (II): Stacks. Queues. Doubly linked lists. Circular lists. (2 hours) • Laboratory-10: Binary Files. (2 hours)
13th	• Binary trees: Routing of binary trees. Binary sorted trees. (2 hours) • Laboratory-11: Simply linked lists. (2 hours)
14th	• Algorithms for data sorting: bubble, selection, insertion and Quicksort. Data search algorithms. (2 hours) • Laboratory-12: Binary trees. (2 hours)
15th	• General review. (2 hours) • Laboratory-13: PEL2 laboratory examination. (2 hours)

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	30 hours in large group 26 hours in small group of laboratory 2 hours for examination
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

- Theoretical lectures in presential mode with slides, drawings and videos in large group of students.
- Resolution of problems in presential mode with slides and drawings in large group.
- Resolution of individual practices for every student in small presential group in the laboratory.

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 May-June

The evaluation in the ordinary call will be inspired in the continuous evaluation criteria, always focused on the acquisition of the skills specified in this course. There are two modalities:

Continuous Evaluación:

It consists of laboratory practices and the realization of two partial theory examinations and two partial laboratory examinations. The laboratory practices will be held once per week during all the semester.

Final Evaluación:

It consists of the realization of a unique final examination with theory and problems. The students must request this type of evaluation to the Director of the Polytechnic School during the first two weeks of classes, stating the reasons why they cannot follow the Continuous Evaluation system. The Director will communicate the resolution in a maximum period of 15 days. If not answered, the request will be considered as accepted.

Extraordinary Call in June-July

The evaluation will consist of an unique final examination with theory and problems.

5.2. EVALUATION

EVALUATION CRITERIA

The evaluation criteria must obey to the acquisiton level of the competencies by the student. For that aim, there are the following criteria:

CE1: The student is able to solve correctly problems that are new and different from the ones solved in the theory and exercise classes, using the contents explained during the lessons and searching for bibliography and information.

CE2: The student knows how to answer short test questions referring to the concepts explained in the classroom.

CE3: The student knows how to create short programs or functions in C language, with a complexity not bigger than the ones explained in the theory classes and the laboratory.

GRADING TOOLS

This section specifies the evaluation instruments applied to the different evaluation criteria.

PEI1: Partial Evaluation Exam 1. This exam will be realized in the middle of the semester period and will consist of one part with test style questions and one part with creation of programs in C language. This partial exam represents the 25% of the total grade of the course. The student not attending this exam will receive a mark of "0" in it, in order to obtain a possible average mark with the second partial exam and the laboratory.

PEI2: Partial Evaluation Exam 2. This exam will be realized at the end of the semester period and will consist of one part with test style questions and one part with creation of programs in C language. This partial exam represents the 25% of the total grade of the course. The student not attending this second exam, regardless if he/she attended or not the first one, will receive a mark of "Not Presented" in the whole course.

PEL1: 1st Evaluation test of the laboratory. It will consist of a test with a computer in the laboratory, regarding the resolution of one or more exercises similar to the ones realized in the laboratory practices. This test will represent the 25% of the grade (2,5 points) and will be realized in the middle of the semester.

PEL2: 2nd Evaluation test of the laboratory. It will consist of a test with a computer in the laboratory, regarding the resolution of one or more exercises similar to the ones realized in the laboratory practices. This test will represent the 25% of the grade (2,5 points) and will be realized at the end of the semester.

The final grade of the laboratory will be the sum of PEL1 + PEL2, giving a maximum of 5 points.

PEF: Final Examination. This exam will be realized at the end of the semester and will consist of one part with test style questions and one part with creation of programs in C language. This exam can only be realized by the students who officially renounced to the Continuous Evaluation process.

GRADING CRITERIA

Ordinary Call with Continuous Evaluation Modality

In the ordinary call with continuous evaluation system, the relations between criteria, instruments and grading are the following:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR5, TR8, TRU1-TRU5, CT2, CT7	RA1, RA2, RA3	CE2, CE3	PEI1	25%
TR2, TR3, TR5, TR8, TRU1-TRU5, CT2,CT7	RA4, RA5, RA6	CE2, CE3	PEI2	25%
TR2, TRU1, CT2, CT7, CT3	RA1-RA6, RA7	CE1	PEL1+PEL2	50%

The student will pass the continuous evaluation if he/she obtains a global mark higher or equal to 5, and obtains in the laboratory grade (PEL1+PEL2) a grade equal to or higher than 1.

The students who are not satisfied with the mark obtained in PEI1, will have the oportunity to change that mark with an aditional partial exam which will be realized together with PEI2. This aditional exam will have the same weight than PEI1 in the final grade of the course.

Ordinary Call with Final Evaluation Modality

It will be realized one final examination which will constitute the 100% of the final grade of the course (10 points). The possible activity done in the laboratory will not be considered.

In the ordinary call with final evaluation system, the relations between criteria, instruments and calification are the following:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR5, TR8, TRU1-TRU5, CT2, CT7, CT3	RA1-RA6, RA7	CE1, CE2, CE3	PEF	100%

The student will pass the final evaluation if he/she obtains a global mark higher or equal to 5.

Extraordinary Call

The students who did not pass the course in the ordinary call will realize a new unique exam constituting the 100% of the final grade of the course.

In this case, the possible attendance to the laboratory during the semester can count towards the final grade of the course, since this will be calculated as maximum value between 100% final exam, or 50% final exam + 50% laboratory (the biggest garde of both).

In the extraordinary call, the relations between criteria, instruments and calification are the following:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
Option 1: TR2, TR3, TR5, TR8, TRU1-TRU5, CT2, CT7, CT3	RA1-RA6, RA7	CE1, CE2, CE3	PEF	100%
Option 2: TR2, TR3, TR5, TR8, TRU1-TRU5, CT2, CT7, CT3	RA1-RA6, RA7	CE2,CE3 CE1	PEF PEL1+PEL2	50% 50%

The student will pass the extraordinary call if he/she obtains a global mark higher or equal to 5.

The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Theory Handbook provided by the Departament.
- Course of C/C++ Programación. Fco Javier Ceballos, Ed. RA-MA.
- Unix, advanced programming. Francisco Marquez Garcia, Ed. RA-MA.

6.2. Additional Bibliography

- Structures of information with C and C ++, Langsam, Augenstein, Tenenbaum, Prentice Hall

Hispanoamericana 1997 INF/681.3.01/LAN
- The C programming language. Ed. Prentice Hall. Kernighan and D. M. Ritchie.
- How to programme in C/C ++. Ed. Prentice Hall. H.M.Deitel and P.J.Deitel.
- Introduction to computer science. McGraw Hill. Blackish, Lloris, Towers.
- “100 Problemas resueltos de programación en lenguaje C para ingeniería”: Ed. Paraninfo. Alvarado, Maestre, Vivas, Zafra.

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.