



INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingenieria de  
Sistemas Informaticos

# ANX-PR/CL/001-01

## LEARNING GUIDE

SUBJECT

**615000248 Translators of Programming Languages**

DEGREE PROGRAMME

61IW – Degree in Software Engineering

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

## Index

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### Learning guide

1. Description. ....	1
2. Faculty .....	1
3. Prior knowledge recommended to take the subject .....	2
4. Skills and learning outcomes .....	2
5. Brief description of the subject and syllabus .....	3
6. Schedule. ....	5
7. Activities and assessment criteria .....	7
8. Teaching resources .....	9
9. Other information. ....	10

## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	615000248- Translators of Programming Language
<b>No of credits</b>	6 ECTS
<b>Type</b>	Mandatory
<b>Academic year of the programme</b>	Third year
<b>Semester of tuition</b>	Semester 6
<b>Tuition period</b>	February - June
<b>Tuition languages</b>	English
<b>Degree programme</b>	61IW – Software Engineering Bachelor
<b>Centre</b>	61 - Escuela Tecnica Superior De Ingenieria De Sistemas Informaticos
<b>Academic year</b>	2022-23

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
José Ramón Sánchez Couso (Subject coordinator)	1204	joseramon.sanchez.couso@upm.es	To be confirmed.
Victor Mitrana	1227	victor.mitrana@upm.es	To be confirmed.

\* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

## 3. Prior knowledge recommended to take the subject

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### 3.1. Recommended (passed) subjects

- Programming Fundamentals
- Logic and Discrete Mathematics
- Data Structure

### 3.2. Other recommended learning outcomes

## 4. Skills and learning outcomes \*

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### 4.1. Competences

CC6 - Knowledge and application of the basic algorithmic procedures of computer technologies to design solutions to problems, analyzing the suitability and complexity of the proposed algorithms.

TC6 - Critical reasoning: The ability to think critically implies three things: (1) an attitude for considering, in a reflective way the problems and issues; (2) knowledge of the methods of logical inquiry and reasoning, and (3) some skill in the application of those methods.

### 4.2. Learning outcomes

- RA326 - Critical reasoning
- RA23 - Solves problems by defining the significant elements that constitute them, providing reasoned arguments and expressing precise conclusions.
- RA246 - Applies the fundamentals of pushdown automata.
- RA245 - Applies the fundamentals of syntactic analyzers.
- RA81 - Evaluates characteristics of programming languages with implementation in mind.
- RA243 - Understands the fundamentals of formal languages.
- RA76 - Implements lexical-syntactic analyzers that generate concrete or abstract syntax trees (AST).
- RA244 - Analyzes and writes Type 2 grammars.
- RA241 - Uses regular mechanisms for specification.

## 5. Brief description of the subject and syllabus

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### 5.1. Brief description of the subject

Formal Language Theory and its Application in the Theory and Design of Programming Languages.

#### Syllabus

1. Formal and programming languages
  - 1.1. Basic concepts
  - 1.2. Operations with formal languages
  - 1.3. Specification of formal languages
  - 1.4. Programming languages and their connection with formal languages
2. Regular languages
  - 2.1. Regular expressions
  - 2.2. Finite automata
  - 2.3. Regular grammars
  - 2.4. Transformations between regular mechanisms
  - 2.5. Properties of regular languages
3. Lexicographic aspects
  - 3.1. Formal specification of lexicography
  - 3.2. Fundamentals of a lexical analyzer
4. Context-free languages
  - 4.1. Context-free grammars
  - 4.2. Transformations of context-free grammars
  - 4.3. Chomsky normal form: CYK algorithm
  - 4.4. Properties of free context languages
  - 4.5. Pushdown automata
5. Syntactic aspects
  - 5.1. Formal specification of syntax
  - 5.2. Top-down syntactic parsers
  - 5.3. Bottom-up syntactic parsers
  - 5.4. LL(k) and LR(k) grammars
  - 5.5. Applications of LL(1) grammars in the syntactic analysis
6. Context-dependent and recursively enumerable languages. 6.1. Turing Machines

6.2. Arbitrary Generative Grammars

6.3. Basic aspects of computability and complexity

## 6. Schedule

### 6.1. Subject schedule\*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	<b>Subject presentation and chapter 1</b> Lecture <b>Chapter 1</b>	<b>Topic 1.</b> Duration: 02:00		
2	<b>Chapter 2.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 2.</b> Duration: 02:00		
3	<b>Chapter 2.</b> <b>LM: Actividad tipo Lección Magistral</b>	<b>Topic 2.</b> Duration: 02:00		
4	<b>Chapter 2.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 2.</b> Duration: 02:00		
5	<b>Chapter 2</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 2.</b> Duration: 02:00		
6	<b>Chapter 3</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 3.</b> Duration: 02:00		
7	<b>Chapter 4</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 4.</b> Duration: 02:00		
8	<b>Chapter 4.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral			Exam Topics 1-3 (Block I, 1st Non-recoverable Evaluation) EX: Assessment Technique: Written Exam Continuous Assessment In-Person Duration: 02:00



9	Chapter 4	<b>Topic 4.</b> Duration: 02:00		
10	<b>Chapter 4.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 4.</b> Duration: 02:00		
11	<b>Chapter 4.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 4.</b> Duration: 02:00		
12	<b>Chapter 4.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 4.</b> Duration: 02:00		
13	<b>Chapter 5.</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 5.</b> Duration: 02:00		
14	<b>Chapter 5</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 5.</b> Duration: 02:00		
15	<b>Chapter 6</b> Duración: 02:00 LM: Actividad del tipo Lección Magistral	<b>Topic 6.</b> Duration: 02:00		
16				
17				Exam Topics 4-6 (Block II, 2nd Non-recoverable Evaluation) EX: Assessment Technique: Written Exam Final Exam Assessment Only In-Person Duration: 02:55

## 7. Activities and assessment criteria

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### 7.1. Assessment activities

#### 7.1.1. Assessment for progressive attendance

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
8	Exam Topics 1-3 (Block I, 1st evaluation not recoverable)	Written exam	Face to face	02:00	40%	0/10	CC6 CT6

#### 7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Exam Topics 4-6 (Block I, 2nd evaluation not recoverable)	Written exam	Face to face	03:00	60%	3/10	CC6 CT6

#### 7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Global theory exam (	Written exam	Face to face	0300	100%	5 10	CC6 CT6



## 7.2.

### 7.3. Assessment criteria

The evaluation in the June session consists of the two non-recoverable exams described above, which will assess the following learning outcomes: RA326, RA241, RA243, RA244, RA245, RA246, RA76, RA81, RA23. The first exam, corresponding to Block I, takes place in the 8th week and covers Topics 1-3 with a weight of 40% of the total evaluation. The second exam, corresponding to Block II, takes place at the end of the course and covers Topics 4-6 with a weight of 60% of the total evaluation. This evaluation system is equivalent to the overall assessment, except that it allows for the redistribution of the exam material over time (week 8), thus avoiding its concentration at the end of the course.

To pass the June session, a grade equal to or greater than 5 must be obtained after adding the scores of Blocks I and II, provided that the requirement of obtaining at least 30% of the score assigned to Block II is met.

If the student does not pass the course in this session, the grade obtained in either part (Block I or Block II) will be saved for the July session, if requested by the student, as long as the score obtained is equal to or higher than 50% of the grade assigned to that specific part.

In order to pass the course in the July session, the student must obtain a grade equal to or higher than 5 after adding the grades obtained in Block I and Block II, provided that the minimum required grade is obtained in Block II.

#### Evaluation:

There will be one exam worth 100% of the grade, in which the following learning outcomes will be assessed: RA326, RA241, RA243, RA244, RA245, RA246, RA76, RA81, RA23. The exam will consist of two blocks that will be completed together in the same session: the first block covers Topics 1-3 with a weight of 40% of the total evaluation, and the second block covers Topics 4-6 with a weight of 60% of the total evaluation. To pass in this session, a grade equal to or higher than 5 must be obtained after adding the grades from both blocks, provided that the requirement of obtaining at least 30% of the score in Block II is met.

Students who chose to keep the grade of either part (Block I or Block II) from the June session will only take the part they didn't pass, unless they communicate that they renounce this option. In the latter case, they will take the entire exam, and any previous grades obtained will not be taken into account.

## 8. Teaching resources

### 8.1. Teaching resources for the subject

Name	Type	Notes
Moodle UPM	Web resource	The whole pack of documentation and examples used in class by the teacher. It is documentation elaborated by the teacher
Teoría de Lenguajes de Programación. Una Aproximación Práctica a la Teoría de Autómatas y Lenguajes Formales. J.Alberto de Frutos Velasco, Jesús López Sánchez, José Gabriel Pérez Díez. Departamento de Publicaciones ETSISI	Bibliography	Main book.
Introduction to Automata Theory, Languages and Computation. J.E. Hopcroft & J.D. Ullman. Addison-Wesley, 1979.	Bibliography	Basic book for reference.
The Theory of Parsing, Translation and Compiling. Volume I. Alfred V. Aho, Jeffrey D. Ullman. Prentice Hall, 1972	Bibliography	Complementary book
Concepts of Programming Languages. Robert W. Sebesta. Pearson International, 2008	Bibliography	Complementary book.
Compilers: Principles, Techniques, & Tools. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman. Addison Wesley 2007	Bibliography	Complementary book.

## 9. Other information

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### COMMON COMPETENCES

In this course, the cross-cutting competency of critical thinking is developed and evaluated through exercises.