

Academic Year: ( 2021 / 2022 )

Review date: 29-06-2021

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: GARCIA HERRERO, JESUS

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Programming (1º, 1C)

Automata and Formal Language Theory (2º, 1C)

**OBJECTIVES**

Cognitive

1. Knowledge on theoretical basis of automata and formal languages
2. Knowledge on techniques for lexical, syntactic and semantic analysis
3. Techniques for code generation
4. Techniques for error recovery
5. Knowledge on code optimization methods

- Procedimental/Instrumental

1. Design of a formal grammar
2. Design of a lexical and syntactic analyzers
3. Use of automatic tools (meta-compilers) for generation of analyzers

- Attitudinal

1. Ability to generate new ideas (creativity)
2. Concern with quality
3. Motivation for success
4. Interest for investigating and finding solutions to new problems

**DESCRIPTION OF CONTENTS: PROGRAMME**

Descriptors: Representation of formal languages, lexical analysis, syntactic analysis, semantic analysis, code generation, error recovery, code optimization

**UNIT I: Introduction**

History of compilers and languages

Basics

Languages and grammars

Formal definitions of Grammar, Regular Expressions and Automata

Phases and structure of a compiler

Tombstone diagrams

**TOPIC II: Lexical Analysis**

Design of a Lexical Analyzer

Finite Automata Regular Languages &amp; recognizers

Construction of a Finite Automaton. Examples

Automatic Lexical Analyzer Generator: LEX

Handling Lexical Errors

**THEME III: Parsing**

Introduction to Syntactic Analysis

Classification of methods of syntactic analysis

Descending Scan, Syntactic LL

LL obtaining table (1). Examples

Ascending Scan, Syntactic LR

Treatment of Ambiguous Grammars. Examples

Automatic Parser Generator: YACC

**UNIT IV: Treatment of Syntactic Errors**

Errors. Detection and Recovery Strategies. Examples

Recovery with different analyzers

Descent parser LL

Up operator precedence parser

Ascending LR Parser

UNIT V: Semantic Analysis

Attribute Grammars, Examples, Registration

Specifying a translator: Translation Directed by Syntax and Translation Schemes

Evaluation of grammars

Construction of Abstract Syntax Trees

UNIT VI: Verification of Types

Introduction

Type expressions

Type systems. Checking static and dynamic

Sample construction and verification of simple types

Equivalence of type expressions

Overloading and Object Orientation

UNIT VII: Intermediate Code Generation

Types of Intermediate Languages

Codes three directions. Alternatives

Intermediate code generation: statements, arithmetic expressions, arrays

Control Flow Statements

UNIT VIII: Machine Code Generation

Machine and target machine code

Options machine code

Instructions and addressing and cost

Simple code generation from intermediate language

Basic blocks and flow graphs

Register allocation

Translation of other instructions

UNIT IX: Table of Symbols and Execution Environment

Memory allocation

Static and dynamic allocation

Stack and heap management. Examples

Function calls

Activation records

Passing parameters

Operations and organization of the symbol table

UNIT X: Code Optimization

Code optimization concept

Local optimization of basic blocks

Function preserving transformations

Elimination of dead code

Loops optimizatio

Global analysis of the data stream

UNIT XI: Specific Aspects

Other language processor

interpreter

Preprocesadores and macroprocesadores

Language desig

Data structures and contro

Aspects of compilation for specific types of language

Examples of compilers

## LEARNING ACTIVITIES AND METHODOLOGY

Theoretical lectures: 1.5 ECTS. To achieve the specific cognitive competences of the course.

Practical lectures: 1,5 ECTS. To develop the specific instrumental competences and most of the general competences, such as analysis, abstraction, problem solving and capacity to apply theoretical concepts.

Besides, to develop the specific attitudinal competences. They consist in proposing during the practical lectures a compiler/interpreter project to be developed in teamwork.

-Guided academic activities (present teacher): 1 ECTS. The student proposes a project according to the teachers guidance to go deeply into some aspect of the course, followed by public presentation.

-Guided academic activities (absent teacher): 1.5 ECTS. Exercises and complementary readings proposed by teacher. Exercises and examination: 0,5 ECTS. To complete the development of specific cognitive and procedimental capacities.

#### ASSESSMENT SYSTEM

Exercises and examinations are both learning and evaluation activities. The evaluation system includes the assessment of guided academic activities and practical cases, with the following weights:

Exercises and examination: 40%

Practical case: 40%

Guided academic activities

- Present teacher: 15%

- Absent teacher: 5%

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|-----------------------------------|----|
| <b>% end-of-term-examination:</b> | 40 |
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| <b>% of continuous assessment (assignments, laboratory, practicals...):</b> | 60 |
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#### BASIC BIBLIOGRAPHY

- A. V. Aho and Ravi Sethi and J. D. Ullman Compiladores: Principios, Técnicas y Herramientas, Addison-Wesley Iberoamericana, 1990.

- Kenneth C. Loudon Construcción de Compiladores. Principios y práctica, Thomson, 2004.

#### ADDITIONAL BIBLIOGRAPHY

- Dick Grune, Henri E. Bal, Criel J.H. Jacobs, Koen G. Langendoen Modern Compiler Design, John Wiley & Sons, 2000.

- Doug Brown, John Levine, Tony Mason Lex & Yacc, O'Reilly Media, Inc., 1995.

- F. J. Sanchis and C. Galán Compiladores: Teoría y Construcción, Paraninfo, 1986.

- Garrido, Iñesta, Moreno, Pérez Diseño de Compiladores, Publicaciones Universidad de Alicante, 2002.