SUBJECT TEACHING GUIDE

340 - Computational Complexity

Master's Degree in Mathematics and Computing

Academic year 2025-2026

1. IDENTIFYING DATA					
Degree	Master's Degree in Mathematics and Computing			Type and Year	Compulsory. Year 1
Faculty	Faculty of Sciences				
Discipline					
Course unit title and code	340 - Computational Complexity				
Number of ECTS credits allocated	3	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICAS, ESTADISTICA Y COMPUTACION
Name of lecturer	CAMILO PALAZUELOS CALDERON
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Other lecturers	

3.1 LEARNING OUTCOMES

- Introduction to basic aspect of Computational Complexity: Turing machines. Universal Turing machine and Halting Problem. Time and Space complexity classes. Determinism and Non-determinism. Assymptoc classes: Linear Speed-Up, Tape Compression Lemma. M. Blum's Theorem. Central complexity classes. Randomized algorithms, classes and relations among them. NP-completeness and reductions: Turing, Cook. Cook's Theorem. Introduction to interactive protocols. Shamir's Theorem.

4. OBJECTIVES

Foundations of algorithmic analysis of efficiency.: How to analyze the complexity of an algorithm and know the most usual complexity classes and their relations.

6. SUBJECT PROGRAM	
CONTENTS	
1	Introduction to basic aspects of computational complexity: Turing machines, universal Turing machines, Gödel diagonalization, recursively enumerable languages, halting problem.
2	Time and space complexity classes. Determinism versus non-determinism. Asymptotic classes (linear speed-up and tape compression lemma). Blum's Theorem. Elementary relations.
3	Central complexity classes. First relations. Time, space and non-determinism. Randomized algorithms. Examples.
4	Complete problems. Cook's conjecture. Examples of classic NP-complete problems. The polynomial hierarchy. Shamir's theorem.

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Project (developed either individually or in small groups)	Work	No	Yes	60,00
Final exam	Written exam	No	Yes	40,00
TOTAL				100,00
Observations				
If the quota of honors for the course is filled during the regular exam session, students who take the extraordinary exam session will not be eligible for the grade of honors.				
Observations for part-time students				
Part-time students must follow the same guidelines as full-time students.				

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
S. Arora, B. Barak, "Computational Complexity: A Modern Approach", Cambridge University Press, 2009.
L. A. Hermaspaandra, M. Ogihara, "The Complexity Theory Companion", Springer, 2002.