

SUBJECT TEACHING GUIDE

M1498 - Combinatorial Optimisation

Master's Degree in Mathematics and Computing

Academic year 2019-2020

| 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 | M1498 - Combinatorial Optimisation | | | | |
| Number of ECTS credits allocated | 3 | Term | Semester based (1) | | |
| Web | | | | | |
| Language of instruction | Spanish | English Friendly | Yes | Mode of delivery | Face-to-face |

| | | | | | |
|------------------|---|--|--|--|--|
| Department | DPTO. MATEMATICAS, ESTADISTICA Y COMPUTACION | | | | |
| Name of lecturer | FRANCISCO SANTOS LEAL | | | | |
| E-mail | francisco.santos@unican.es | | | | |
| Office | Facultad de Ciencias. Planta: + 3. DESPACHO PROFESORES (3013) | | | | |
| Other lecturers | | | | | |

3.1 LEARNING OUTCOMES

- To get acquainted, understand, and be able to apply, techniques of discrete combinatorial optimization and understand their role within mathematics and computer science.

4. OBJECTIVES

Techniques and algorithms for optimization in discrete problems will be studied. Goals are:

- that the student understand the mathematical fundamentals (geometric, algebraic, and combinatorial) behind the problems under treatment.
- that students understand the algorithms that solve these problems optimally, as well as (a first approximation to) their computational complexity.
- that students understand that in certain problems it is too expensive to apply exact algorithms, so approximation algorithms need to be studied.

6. COURSE ORGANIZATION

CONTENTS

| | |
|---|---|
| 1 | Polyhedral combinatorics and linear programming (polytopes and polyhedra, Farkas Lemma, linear programming, duality). |
| 2 | Matchings in bipartite and non-bipartite graphs (hall and Gallai theorems, augmenting paths, the matching polytope). |
| 3 | Flows in graphs. The max-flow-min-cut Theorem. Linear programming interpretation. |
| 4 | Integer linear programming. Totally unimodular matrices. Cut hyperplanes. |

7. ASSESSMENT METHODS AND CRITERIA

| Description | Type | Final Eval. | Reassessn | % |
|---|--------------|-------------|-----------|--------|
| The student will write the solutions to some problems and hand them to the professor. | Work | No | Yes | 60,00 |
| Final exam. | Written exam | Yes | Yes | 40,00 |
| TOTAL | | | | 100,00 |
| Observations | | | | |
| Observations for part-time students | | | | |

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Lee J. A first course in combinatorial optimization (Cambridge University Press, 2004)