SUBJECT TEACHING GUIDE

G2004 - DISCRETE MATHEMATICS

Double Degree in Physics and Mathematics
Degree in Mathematics

Academic year 2021-2022

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Mathematics			Type and Year	Compulsory. Year 3 Compulsory. Year 2
Faculty	Faculty of Sciences				
Discipline	Subject Area: Computational Mathematics Module: Compulsory Subjects				
Course unit title and code	G2004 - DISCRETE MATHEMATICS				
Number of ECTS credits allocated	6	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	MARIO ALFREDO FIORAVANTI VILLANUEVA
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Other lecturers	

3.1 LEARNING OUTCOMES
- To learn basic counting principles and some elements of combinatorial structures.
- To be able to compute exactly and/or approximately the number of objects of several types.
- To be able to solve linear recurrence relations and understand the asymptotic behavior of the sequences they define.
- To know how to construct certain linear codes and analyze their error-correcting capacity.
- To know and be able to interpret and apply in concrete examples basic concepts of graph theory.
- To know and be able to apply in concrete examples several graph theory algorithms.

4. OBJECTIVES

Discrete mathematics is an increasingly important branch of mathematics, both pure and applied. This course intends to give an overview of it focusing on two topics: graph theory, which models many networks, processes, diagrams or relations among discrete objects, and enumerative combinatorics, that is to say, techniques to count the number of elements in a finite set, and its applications. As an example of algebraic techniques in combinatorics, linear error-correcting codes are studied. These codes are used in current digital data transmission and storage.

6. COURSE ORGANIZATION

CONTENTS	
1	Combinatorics. Introduction to combinatorics. Factorial and binomial numbers. Binomial theorem. Inclusion-exclusion principle. Generating functions. Formal power series and generating functions. Homogeneous linear recurrences. Fibonacci and Catalan numbers. Partitions of a positive integer.
2	Coding Theory. Codes. Words, codes, and errors. Hamming distance. Correcting capacity of a code. Minimum distance decoding. Linear codes. Linear codes over finite fields. Syndrome decoding. Examples: Hamming, Golay, and Reed-Muller codes.
3	Graph Theory. Graphs. Gepresentation of graphs. Isomorphism. Paths and cycles. Eulerian and Hamiltonian graphs. Trees and search algorithms. Spanning trees. Depth first search and breadth first search. Dijkstra□s algorithm. Rooted trees. Binary trees. Bipartite graphs. Matchings, maximal and perfect matchings. Augenting path algorithm. Hall□s theorem. Digraphs and networks. Directed graphs. Networks. Flows and cuts. Max-flow-min-cut algorithm. Planar graphs. Kuratowski□s Theorem. Euler□s formula. Four color theorem. Graph coloring.
4	Preparation and realization of final exam.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
One hour tests (30%)	Written exam	No	Yes	30,00
Final exam (50%)	Written exam	Yes	Yes	54,00
Handed assignments (20%)	Work	No	Yes	16,00
TOTAL				100,00

Observations
Observations for part-time students
Same as full-time students.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
N. Biggs: Discrete Mathematics, Revised edition, Clarendon Press, Oxford, 1989.
R. P. Grimaldi: Discrete and combinatorial mathematics, an applied introduction. Addison-Wesley, 1989.