

Course Unit	Discrete Mathematics		Field of study	Mathematics	
Bachelor in	Informatics Engineering		School	School of Technology and Management	
Academic Year	2021/2022	Year of study	1	Level	1-1
Type	Semestral	Semester	2	ECTS credits	6.0
Code	9119-706-1203-00-21				
Workload (hours)	162	Contact hours	T -	TP 60	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Edite Martins Cordeiro, Maria Fátima Moreira da Silva Pacheco

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Master the basics of logic, logical operations and their properties.
2. Operate with sets and evaluate relations and entire functions and their properties.
3. Prove propositions and algorithms using the method of finite induction.
4. Use the Euclidean algorithm to calculate the greatest common divisor of two numbers and for solving Diophantine equations.
5. Solve counting problems by applying combinatorial calculus and binomial and multinomial theorems.
6. In graphs, determine: order, paths and circuits, isomorphism, planarity, chromatic number. Apply the algorithms of Prim, Kruskal and Dijkstra.

### Prerequisites

Before the course unit the learner is expected to be able to:  
Have skills to apply the mathematical concepts taught during high school.

### Course contents

Logic and set theory. Number Theory. Elementary Principles of Counting. Induction and Recursion. Introduction to Graph Theory.

### Course contents (extended version)

1. Logic and set theory
  - Propositional logic, logical implication, inference rules, valid and invalid arguments.
  - Predicate logics, quantifiers.
  - Sets and subsets. Operations with sets and related properties.
2. Number Theory
  - Relationships and discrete functions.
  - Prime numbers, Euclid's theorem and the fundamental theorem of arithmetic.
  - Resolution of recurrence relations.
  - Mathematical induction.
3. Elementary Principles of Counting
  - Permutations and combinations of a set of elements. Multinomial theorem.
  - The pigeonhole principle.
  - Lexicographical ordering of combinations and permutations.
4. Graph Theory
  - Graph isomorphism, planar graphs, graph coloring, Euler and Hamilton paths and circuits.
  - Trees, n-ary trees, depth-first and depth-first search algorithms.
  - Minimal spanning tree, Kruskal and Prim algorithms, Dijkstra algorithm. Applications.

### Recommended reading

1. E. Cordeiro, Notas Teóricas e Práticas de Matemática Discreta, 2020
2. Edite Cordeiro, Folha Prática Nº 1, Nº2, Nº 3, Nº4, 2020
3. William Stein, Elementary Number Theory: Primes, Congruences, and Secrets, Springer, 2011
4. E. G. Goodaire e M. M. Parmenter, Discrete Mathematics with Graph Theory, Prentice Hall, 1998
5. R. J. Wilson, Introduction to Graph Theory, Longman, 1999

### Teaching and learning methods

The contents will be introduced in the classroom.  
The deepening of the contents will be developed outside the classroom, and the topics will be explored through the completion of tasks.

The students will be challenged to watch selected videos (in the MathE and Coursera platforms) about the topics to be studied in the following class, following a «flipped classroom» inspired approach.

### Assessment methods

1. Distributed evaluation - (Regular, Student Worker) (Final)
  - Intermediate Written Test - 40% (Proof of the duration of 1 hour to evaluate the competences acquired in Topics 1 and 2.)
  - Intermediate Written Test - 40% (Proof of the duration of 1 hour to evaluate the competences acquired in Topics 3 and 4.)
  - Practical Work - 20% (Activities for the consolidation of the contents covered.)
2. Final exam - (Regular, Student Worker) (Supplementary, Special)
  - Final Written Exam - 100% (Two hours exam to evaluate the competences acquired in Topics 1, 2, 3 and 4.)

### Language of instruction

1. Portuguese, with additional English support for foreign students.
2. English

## Electronic validation

Edite Martins Cordeiro, Maria Fátima Moreira da Silva Pacheco	Florbela Alexandra Pires Fernandes	Luísa Maria Garcia Jorge	Paulo Alexandre Vara Alves
03-03-2022	04-03-2022	22-03-2022	25-03-2022