INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Discrete Mathematics		Field of study	Mathematics
Bachelor in	Informatics Engineering		School	School of Technology and Management

Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9119-706-1203-00-22		

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 relationships 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 the combinatorial calculus and binomial and multinomial theorems.
6. Determine order, paths and circuits, isomorphism, planarity, chromatic number of a graph. Applt 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 Logics, logical implication, inference rules, valid and invalid arguments.
   - Predicate logics, quantifiers.
   - Sets and subsets. Operations with sets and related properties.
2. Number Theory
   - Binary relations and discrete functions.
   - Prime numbers, Euclid's theorem, and the fundamental theorem of arithmetic.
   - Resolution of recurrence relations
   - Mathematical induction.
3. Elementary Counting Principles
   - 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. Pacheco, Maria F., Notes on Discrete Mathematics, 2023

Teaching and learning methods

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

Assessment methods

1. Distributed (Portuguese and English groups) - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 40% (Test (1 hour) to evaluate the competencies acquired in Topics 1 and 2.)
   - Intermediate Written Test - 40% (Test (1 hour) to evaluate the competencies acquired in Topics 3 and 4.)
   - Practical Work - 20% (Activities for the consolidation of the contents covered.)
2. Final exam (Portuguese and English groups) - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Exam (2 hours) to evaluate the competencies 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	José Carlos Rufino Amaro
19-03-2023	19-03-2023	27-03-2023	27-03-2023