INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Discrete Mathematics			Field of study	Mathematical and Quantitative Methods		
Bachelor in	Informatics and Communications			School	School of Public Management, Communication and Tourism		
Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9188-320-1103-00-22		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT 20	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): Monica Penarroias Branco Carneiro

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. get the logical value of a logical expression known its entrances; simplify logical expressions;
2. know the operations on sets and apply them in problem solving;
3. know some counting techniques and apply them in problem solving;
4. read numbers in some bases and to convert them to different bases; capable to operate in fixed and floating point;
5. prove conjectures using the method of mathematical induction;
6. operate in modular arithmetic; identify order relations;
7. construct graphs and identify its proprieties;
8. determine spanning trees and optimal paths in connected graphs.

Prerequisites

Before the course unit the learner is expected to be able to:
use the language and elementary techniques of mathematics learned in secondary and basic education.

Course contents

Propositional Calculus. Elementary set theory. Elementary counting techniques. Numeral systems. Induction and recursion. Binary relations. Introduction on graph theory.

Course contents (extended version)

1. LOGIC
   - Propositional Calculus;
   - Logical operations on proposals: negation, conjunction and disjunction;
   - Implication and equivalence;
   - Truth tables;
   - Properties of the propositional calculus;
   - Logical operations on conditions;
   - Expressions with variables;
   - Quantifiers;
   - Simplification of logical expressions.
2. ELEMENTARY SET THEORY
   - Equality of sets: extension axiom;
   - Inclusion;
   - Null set and singular set;
   - Union, intersection and complementary sets;
   - Venn's diagrams;
   - Cartesian product and powerset of a sets;
   - Properties of set operation;
   - Cardinality.
3. ELEMENTARY COUNTING TECHNIQUES
   - The adiction rule, inclusion- exclusion rule and multiplication rule;
   - Simple arrangements and composites, permutations;
   - Combinations;
   - Arrangement and combination with repetition.
4. NUMERAL SYSTEMS
   - Positional and non-positional numeral systems;
   - Numeral bases and decimal, binary, octal and hexadecimal bases;
   - Converting from decimal base to other bases;
   - Converting between binary, octal and hexadecimal bases;
   - Signed integers representations: sign-magnitude and complements;
   - Fixed-point arithmetic;
   - Floating-point representation.
5. INDUCTION AND RECURSION
   - Sequences. Defining sequences by general formula and recursively;
   - Mathematical induction;
   - Proving properties by induction.
6. BINARY RELATIONS
   - Definition and properties of the binary relations;
   - Equivalence relation and class of equivalence;
   - Congruencies: examples of application;
   - Order relations and Hasse diagrams.
7. INTRODUCTION TO GRAPH THEORY
   - Simple graphs, connected, bipartite, complete graphs, Euler graphs and Hamilton;
   - Minimum spanning tree - Kruskal´s algorithm and Prim´s algorithm;
   - Digraphs;
   - Binary tree of Huffman's algorithm.

Recommended reading

1. CARDOSO, D. , SZYMANSKI, J. & ROSTAMI, M. (2009). Matemática Discreta: Combinatória, Teoria dos Grafos, Algoritmos. Escolar Editora [ISBN-13: 978-972-592-237-8]
2. EPP, Susanna (2011). Discrete Mathematics and Applications (4th ed.). Brooks/Cole CENGAGE Learning [ISBN-13: 978-0-495-82616-3]
3. GOODAIRE, E. G. & PARMENTER, M. (2006). Discrete Mathematics with Graph Theory. (3rd ed.). Pearson [ISBN-13: 978-0131679955]

Recommended reading

4. LEVIN, Oscar (2018). Discrete Mathematics An open introduction (3rd ed.). SMS University of Northern Colorado [ISBN-13: 978-1792901690]
5. BARBEDO, Inês (2018) Apontamentos de Matemática Discreta, EsACT

Teaching and learning methods

For each subject they are considered periodically, with antecedence, modules of work with communication of the contents; solved exercises; exercises of guided resolution; complementary exercises, stimulating the work in equips; The lessons will be guided in the direction of to check the difficulties of execution of the considered works; to explain contents and examples on the practical cases.

Assessment methods

1. Continous Evaluation 1 - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 25% (25th October - Bivalent Logic/Elementary Set Theory (minimum mark 1. 5 point in 5))
   - Intermediate Written Test - 25% (22th November - Elementary Counting Techniques/ Numbering Systems (minimum mark 1. 5 point in 5))
   - Intermediate Written Test - 25% (13th December -Induction and Recursion/ Binary Relations (minimum mark 1. 5 point in 5))
   - Intermediate Written Test - 25% (17th January - Introduction to Graph Theory (minimum mark 1. 5 point in 5))
2. Distributed Evaluation 2 - (Regular, Student Worker) (Final)
   - Final Written Exam - 100% (Exam with 4 parts: student can solve only some parts if there was a minimum grade in cont evaluation)
3. Final Exame Evaluation - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100% (Elements of evaluation performed earlier are not considered.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Monica Penarroias Branco Carneiro	Vítor José Domingues Mendonça	Elisabete da Anunciacao Paulo Morais	Luisa Margarida Barata Lopes
03-10-2022	09-10-2022	10-10-2022	13-10-2022