San Pablo Catholic University (UCSP)
Undergraduate Program in
Computer Science
SILABO

Universidad Católica San Pablo
2023-II

CS1D2. Discrete Structures II (Mandatory)

1. General information		
1.1 School	:	Ciencia de la Computación
1.2 Course	:	CS1D2. Discrete Structures II
1.3 Semester	:	2^{do} Semestre.
1.4 Prerrequisites	:	CS1D1. Discrete Structures I. (1^{st} Sem)
1.5 Type of course	:	Mandatory
1.6 Learning modality	:	Face to face
1.7 Horas	:	2 HT; 4 HP;
1.8 Credits	:	4
1.9 Plan	:	Plan Curricular 2016

2. Professors

Lecturer

- Daniel Alexis Gutierrez Pachas <dgutierrezp@ucsp.edu.pe>
  - PhD in en Ciencia de la Computación y Matemática Computacional , Universidad de Sao Paulo, Brasil, 2017.
  - MSc in en Matemática, Universidad Federal De Juiz De Fora, Brasil, 2013.
- Luis Fernando Díaz Basurco <ldiaz@ucsp.edu.pe>
  - MSc in Matemática, Pontificia Universidad Católica del Perú, Perú, 1990.

3. Course foundation

In order to understand the advanced computational techniques, the students must have a strong knowledge of the Various discrete structures, structures that will be implemented and used in the laboratory in the programming language..

4. Summary

1. Digital Logic and Data Representation 2. Basics of Counting 3. Graphs and Trees

5. Generales Goals

- That the student is able to model computer science problems using graphs and trees related to data structures.
- That the student applies efficient travel strategies to be able to search data in an optimal way.
- That the student uses the various counting techniques to solve computational problems.

6. Contribution to Outcomes

This discipline contributes to the achievement of the following outcomes:

1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. (**Familiarity**)

6) Apply computer science theory and software development fundamentals to produce computing-based solutions. (**Familiarity**)

7. Content

UNIT 1: Digital Logic and Data Representation (10)	
Competences:	
Content	**Generales Goals**
• Reticles: Types and properties. • Boolean algebras. • Boolean Functions and Expressions. • Representation of Boolean Functions: Normal Disjunctive and Conjunctive Form. • Logical gates. • Circuit Minimization.	• Explain the importance of Boolean algebra as a unification of set theory and propositional logic [Assessment]. • Explain the algebraic structures of reticulum and its types [Assessment]. • Explain the relationship between the reticulum and the ordinate set and the wise use to show that a set is a reticulum [Assessment]. • Explain the properties that satisfies a Boolean algebra [Assessment]. • Demonstrate if a terna formed by a set and two internal operations is or not Boolean algebra [Assessment]. • Find the canonical forms of a Boolean function [Assessment]. • Represent a Boolean function as a Boolean circuit using logic gates [Assessment]. • Minimize a Boolean function. [Assessment].
Readings: Rosen2007, Grimaldi (2003)	

UNIT 2: Basics of Counting (40)

Competences:

Content	**Generales Goals**

• Counting arguments
  – Set cardinality and counting
  – Sum and product rule
  – Inclusion-exclusion principle
  – Arithmetic and geometric progressions
• The pigeonhole principle
• Permutations and combinations
  – Basic definitions
  – Pascal's identity
  – The binomial theorem
• Solving recurrence relations
  – An example of a simple recurrence relation, such as Fibonacci numbers
  – Other examples, showing a variety of solutions
• Basic modular arithmetic
	• Apply counting arguments, including sum and product rules, inclusion-exclusion principle and arithmetic/geometric progressions [Familiarity]
	• Apply the pigeonhole principle in the context of a formal proof [Familiarity]
	• Compute permutations and combinations of a set, and interpret the meaning in the context of the particular application [Familiarity]
	• Map real-world applications to appropriate counting formalisms, such as determining the number of ways to arrange people around a table, subject to constraints on the seating arrangement, or the number of ways to determine certain hands in cards (eg, a full house) [Familiarity]
	• Solve a variety of basic recurrence relations [Familiarity]
	• Analyze a problem to determine underlying recurrence relations [Familiarity]
	• Perform computations involving modular arithmetic [Familiarity]

Readings: Grimaldi (1997)

UNIT 3: Graphs and Trees (40)

Competences:

Content	**Generales Goals**

• Trees
  – Properties
  – Traversal strategies
• Undirected graphs
• Directed graphs
• Weighted graphs
• Spanning trees/forests
• Graph isomorphism
	• Illustrate by example the basic terminology of graph theory, and some of the properties and special cases of each type of graph/tree [Familiarity]
	• Demonstrate different traversal methods for trees and graphs, including pre, post, and in-order traversal of trees [Familiarity]
	• Model a variety of real-world problems in computer science using appropriate forms of graphs and trees, such as representing a network topology or the organization of a hierarchical file system [Familiarity]
	• Show how concepts from graphs and trees appear in data structures, algorithms, proof techniques (structural induction), and counting [Familiarity]
	• Explain how to construct a spanning tree of a graph [Familiarity]
	• Determine if two graphs are isomorphic [Familiarity]

Readings: Johnsonbaugh (1999)

8. Methodology

1. El profesor del curso presentará clases teóricas de los temas señalados en el programa propiciando la intervención de los alumnos.
2. El profesor del curso presentará demostraciones para fundamentar clases teóricas.
3. El profesor y los alumnos realizarán prácticas
4. Los alumnos deberán asistir a clase habiendo leído lo que el profesor va a presentar. De esta manera se facilitará la comprensión y los estudiantes estarán en mejores condiciones de hacer consultas en clase.

9. Assessment

Continuous Assessment 1 : 20 %

Partial Exam : 30 %

Continuous Assessment 2 : 20 %

Final exam : 30 %

References

Grimaldi, R. (1997). *Matemáticas Discretas y Combinatoria.* Addison Wesley Iberoamericana.
Grimaldi, R. (2003). *Discrete and Combinatorial Mathematics: An Applied Introduction.* 5 ed. Pearson.
Johnsonbaugh, Richard (1999). *Matemáticas Discretas.* Prentice Hall, México.