NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF INDUSTRIAL AND SYSTEMS ENGINEERING
SYSTEMS ENGINEERING PROGRAM

SYLLABUS - CB112 DISCRETE MATHEMATICS

I. GENERAL INFORMATION

CODE	:	CB112
SEMESTER	:	3
CREDITS	:	3
HOURS PER WEEK	:	4 (Theory – Practice)
PREREQUISITES	:	CB111 Linear Algebra
CONDITION	:	Compulsory
INSTRUCTOR	:	Jose Benites, Josue Angulo, Paul Tocto

II. COURSE DESCRIPTION

The purpose of this course is to provide students with criteria and methods so that they can model, analyze and set up a base of mathematical structures knowledge which allows them to improve and face continuous changes in informatics. The contents of the course are divided in eight learning units and encompasses the following subjects: Fundamental basics of combinatorial analysis, probability. Integral and modular arithmetic, sequences, equation indifferences, matrices, operations and properties, Boolean matrices, Boolean algebra, relationships, digraph and graph, partial order, lattices, tree and search, groups and semi groups, languages, grammars, finite-state machines, linear transformations, complemented with solutions using (free) mathematical software and/or programming languages.

III. COURSE OUTCOMES

1. Identify the scientific nature of mathematics and assess the rigor and objectivity of the discipline.
2. Use the combinatorial analysis and probability in search resources. Use integral and modular arithmetic to solve numerical problems. Operate Boolean matrices, combinatorial circuits, graphs, lattices, trees and finite-state machines and analytically apply them to the problem solving of the specialization computing problems.
3. Analyze fundamental theorems of mathematics and apply them to situations with specific problems creatively and rigorously.

IV. LEARNING UNITS

1. COMBINATORIAL ANALYSIS AND PROBABILITY. EQUATIONS IN DIFFERENCES / 14 HOURS

Basic notions of combinatorial analysis (Factorial, Combinatorial, permutation and variations) / Elements of probability: Sample space / Conditional probability and independence: Homogeneous and non recurrence linear recurrence / Generating functions method.

2. INTEGRAL AND MODULAR ARITHMETIC / 7 HOURS

Integral arithmetic: Prime numbers T.F. Arithmetic, divisibility. GCD / Euclidean algorithm / Modular arithmetic: Congruence, properties, partitions / Diophantine equations.

3. (NUMERIC AND BOOLEAN) MATRICES. BOOLEAN ALGEBRA / 14 HOURS

Numeric matrices. Properties. Operation / Boolean matrices. Operations / Boolean algebra. Properties / Combinatorial circuits / Boolean functions / Karnaugh's map.

4. RELATIONSHIPS DIGRAPHS AND GRAPHS / 14 HOURS

Relationships. Order relationship / Properties. Transitive relationships / Relationships representation as Boolean matrices / Warshall's algorithm / Graphs. Operation between graphs / Eulerian graph: Circuits and paths / Hamiltonian graph: Circuits and paths.

5. PARTIAL ORDER AND LATTICES / 7 HOURS

Partially ordered Sets (Posets) / Total order / Topological sorting / Lexicographical order / Ends: maximal and minimal elements / Lattices. Properties / Boolean lattices / Isomorphic lattices.

6. TREES AND SEARCH / 14 HOURS

Trees. Properties. Subtrees / Binary trees (Classification) / Hierarchy tree / Labeled trees / Tree path / polish notation /Search / Conversion from general tree to a binary / Non-directed trees / minimum spanning tree / Prim's and Kruskal's algorithms / Treeing. Tree isomorphism.

7. GROUPS AND SEMIGROUPS, LANGUAGES, GRAMMARS AND FINITE-STATE MACHINES / 21 HOURS

Groups, theorems / homomorphism / Isomorphism / Grammar / Theorems / Language representation and special grammars / Syntactic analysis / Finite-state machines / Equivalent machines. Machine simplification / Finite-state machine.

V. LABORATORIES AND PRACTICAL EXPERIENCES:

Lab 1: Probabilities. Recurrence. Integral and modular Arithmetic.
Lab 2: Matrices, Boolean matrices, relationship and graphs.
Lab 3: Partial order, Trees.
Lab 4: Groups, finite-state machines.

VI. METHODOLOGY

The course is carried out in theory, practical and lab sessions. In theory session, the instructor introduces concepts, theorems and applications. In practical sessions, several problems are solved and their solutions are analyzed. In lab sessions, ArTeM free simulation software is used to solve problems and analyze their solutions in integral and modular arithmetic, and Algraph for graphs. Karnaugh Minizer for combinatorial circuits, and C, C++, C# programming languages and java. In all sessions, students' active participation is encouraged.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = (EP+EF+ ((L1+L2+L3+L4)/3 + P1+P2+P3+P4)/4)/3

EP: Mid-Term Exam EF: Final Exam
P#: Quizzes L#: Labs

VIII. BIBLIOGRAPHY

1. **KOLMAN – BUSBY-ROSS**

Discrete mathematics Structures for Computing (Spanish)
Prentice-Hall, Hispanoameriacana S.A., 2002

2. **RALP. P. GRIMALDI**
Combinatorial and Discrete Mathematics (Spanish)
Addison – Wesley Iberoamericana, 2001