University of Puerto Rico
Río Piedras Campus
Department of Mathematics
Undergraduate Program

Course Title: Introduction to Discrete Mathematics.

Code: MATH 3325

Number of Credit/Hours: Three (3) Credits. Three hours of lecture per week.

Prerequisites: MATH 3151 or professor's permission.

Course Description: Logic, basic set theory, proof techniques, relations, functions, countability and counting argument, mathematical induction, graph theory, combinatorics, discrete probability, recurrence relations, number theory and cryptography.

Descripción del curso: Lógica, teoría elemental de conjuntos, técnicas de demostración, relaciones, funciones, Conteo y argumentos de conteo, inducción matemática, teoría de grafos, combinatoría, probabilidad discreta, relaciones de recurrencia, teoría de números y criptografía.

Course Objectives: After this course the students are expected to:

1. be acquired in the basic methods of mathematical reasoning and proof relating to each part of the syllabus;
2. reflect on how the basic methods of mathematics affect the foundations of mathematics knowledge.
3. be able to formulate mathematical definitions and theorems correctly;
4. have acquired a good working knowledge of basic concepts of discrete mathematics;
5. have developed their skills in thinking logically and formulating mathematical arguments;
6. be able to reproduce the proofs of the main results in the syllabus;
7. be able to solve problems relating to the material covered.
8. be able to understand diverse perspectives relating to the production, interpretation and application of knowledge in mathematics;
9. examine diverse methods related to the construction of knowledge in mathematics;
10. examine the contribution of discrete mathematics for the understanding of other disciplines;
11. interrelate knowledge from other disciplines that contribute to discrete mathematics.

Course Outline and Distribution of Time

1. Properties of Numbers. (3 hours)
    a) Numbers
    b) Summation Notation
    c) Bases
    d) Scientific Notation
    e) Arithmetic in Computers

2. Elementary set theory and methods of proof (5 hours)

   a) Propositions and truth tables
   b) Sets and operations on sets
   c) Introduction to Proofs
   d) Syllogisms and Venn diagrams

3. Induction and Recursion (4 hours)

   a) Mathematical Induction
   b) Strong Induction
   c) The well-ordering principle
   d) Recursive definitions, recursive algorithms

4. Boolean Algebras and Circuits. (4 hours)

   a) Boolean Algebras
   b) Boolean Forms
   c) Disjunctive Forms
   d) Digital circuits

5. Relations and Functions (5 hours)

   a) Binary relations
   b) Equivalence relations
   c) Definition of a function
   d) Composition of functions, inverse function

6. Counting (6 hours)

   a) The basics of counting
   b) The inclusion–exclusion principle
   c) Permutations and Combinations
   d) The binomial theorem
   e) Bijections and infinite sets. Finite and infinite sets. Countable sets.

7. Probability (6 hours)

   a) Probability: elementary concepts
   b) Repeated Experiments
   c) Counting and Probability
   d) Conditional Probability
   e) Bayes' Formula

8. Graph Theory (6 hours)

   a) Introduction to Graphs
   b) Walks, Paths and Cycles
   c) Distances and Shortest Path
   d) Trees

e) Hamiltonian Cycles

9. Number Theory and Cryptography (6 hours)

   a) Elementary Number Theory
      1) Primes and divisors
      2) Greatest common divisor and the Euclidian algorithm
   b) Modular arithmetics. Chinese remainder Theorem
   c) Introduction to Cryptography
   d) The RSA system

Instructional Strategies Lecture and class discussion. The course will be supplemented with elementary projects.

Evaluation Strategies Grade will be based on: two partial exams (25 % each), Assignments and projects (20 %), a final exam (30 %).

• According to Law 51 (ADA) alternative evaluation strategies may be used with students who have special needs.

Credit System: A, B, C, D, F.

Textbook: Wallis, W.D. *A Beginner's Guide to Discrete Mathematics*, Birkhäuser, 2003

Bibliography

1. Norman L. Biggs, *Discrete Mathematics*, Oxford University Press, 2 edition (2003).
2. Susanna S. Epp, *Discrete Mathematics with Application*, Brooks Cole; 3 edition (2003)
3. Gary Haggard, John Schlipf, Sue Whitesides, *Discrete Mathematics for Computer Science*, Brooks Cole, (2005)
4. Richard Johnsonbaugh, *Discrete Mathematics*, 7th Edition (2008)
5. R. F. Lax, *Modern Algebra and Discrete Structures*, Harper Collins, (1991)
6. Kennth H Rosen, Discrete Mathematics and its Applications, McGraw-Hill, 5 edition (2006)

Electronic References

1. Edward A. Bender & S. Gill Williamson, *A Short Course in Discrete Mathematics*, http://math.ucsd.edu/ ebender/DiscreteText1/
2. W.W. Chen, *Lecture Notes* htttp://www.maths.mq.edu.au/ wchen/Indmfolder/Indm.html
3. G. MacGillivray, *Lecture Notes* http:www.math.uvic.ca/faculty/gmacgill/guide/

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