**Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica**

# Course catalogue

*Page compiled on 21/07/2018*

## Programme of Integrated course "Matematica Discreta"

This course is composed of 2 Modules: 1) Matematica Discreta I, 2) Matematica Discreta II

## Programme of Module "Matematica Discreta I"

- Code: FN
- Type of course unit: Compulsory (Bachelor Degree in Computer Science curriculum General)
- Level of course unit: Undergraduate Degrees
- Semester: 2

Number of ects credits: (Bachelor Degree in Computer Science) 6 (workload 150 hours)

Teachers: Anna Guerrieri

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| 1 | **Course objectives** | The goal of this course is to expose the main concrete techniques in linear algebra (matrices, systems, determinants, vector spaces and linear maps) and to show the first strategies in abstract algebra. |
| 2 | **Course content and learning outcomes (dublin descriptors)** | Topics of the module include:<br>• Sets: functions, equivalence relations, products, elementary combinatorics.<br>• Permutations.<br>• Groups: subgroups, quotients, isomporphism theorems, factor groups, permutation groups, cyclic groups.<br>• Arithmetic: divisibility theory in the ring of integers and of polinomials over a field.<br>• Congruences. Chinese remainder theorem.<br>• Rings: subrings, ideals, quotients, isomorphism theorem, ring of polynomials, domains, euclidean rings, PID, UFD.<br>• Fields: simple field extensions, finite fields.<br>• Matrices and systems of linear equations: Gauss reduction, determinants.<br>• Vectors, vector spaces, independence, bases.<br>• inner product, cross product.<br>• Eigenvalues, eigenvectors. Diagonalization and canonical forms of matrices.<br>• Application: systems of differential equations.<br><br>On successful completion of this module, the student should :<br><br>• being aware of the main structures in Linear Algebra and Abstract Algebra.<br>• demonstrate skill in mathematical reasoning, manipulation and calculation, demonstrate capacity for finding rigorous proofs of small problems; demonstrate skill in mathematical reasoning, manipulation and calculation by synthesizing geometric concepts into algebraic, functional, and problem-solving activities; demonstrate capacity to deduce properties of, and relationships between, figures from given assumptions and from using transformations. |
| 3 | **Course prerequisites** | Set Theory (language of set theory, the notion of function, graphs of fundamental functions, concept of sufficient and necessary condition), Numerical Structures (natural numbers, prime numbers, numerical fractions, rational numbers, basics of real numbers, inequalities, absolute value, powers and roots); Elementary algebra ( polynomials and operations on polynomials, identity, first- and second-degree equations). |
| 4 | **Teaching methodsand language** | Lectures and exercises<br>**Language**: Italian<br>**Reference textbooks**<br>• W.K. Nicholson, ***Algebra lineare***. McGraw Hill.<br>• B. Scimemi, ***Algebretta***. |
| 5 | **Assessment methods** | Written exam and oral discussion of the written exam. |

## Programme of Module "Matematica Discreta II"

- Code: FN

- Type of course unit: Compulsory (Bachelor Degree in Computer Science curriculum General)
- Level of course unit: Undergraduate Degrees
- Semester: 2

Number of ects credits: (Bachelor Degree in Computer Science) 6 (workload 150 hours)

Teachers: Anna Tozzi (anna.tozzi@univaq.it)

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| **1** | **Course objectives** | LOGIC: The goal of this Module is to provide the motivations, definitions and techniques in support of the usefulness of logic in the effective and efficient modeling of data and knowledge. This Module is an introduction to mathematical logic and covers elementary discrete mathematics for computer science. On successful completion of this module, the student should understand the fundamental concepts of mathematical logic and should be aware of potential applications in computing, including the limitations of algorithms. GEOMETRY: The goals of this Module are to introduce students to the terminology and theorems of plane and solid geometry, and to apply algebraic, spatial, and logical reasoning to solve geometry problems. This Module covers the fundamental concepts of Linear Algebra and its role in describing geometric settings. On successful completion of this module, the student will develop spatial sense, visualize and represent geometric figures , explore transformations of geometric figures, understand and apply geometric properties and relationships, synthesize geometric concepts into algebraic, functional, and problem-solving activities. |
| **2** | **Course content and learning outcomes (dublin descriptors)** | Topics of the module include:<br>• LOGIC Propositional Logic: Logical formulae, valuations, truth tables, logical equivalence of formulae, satisfaction and logical implication. Deductive Logic: Formal axiom schemes, the structure of formal proofs, Sequent Calculus, Natural Deduction, the Deduction Theorem, and connections between truth and proof (the Soundness and Completeness Theorems).<br>• GEOMETRY Euclidean plane geometry, angles, radians, notion of geometric place, properties of triangles, parallelograms, circles, symmetry and similarity, transformations in the plane, Cartesian coordinates and equations of simple geometric places, elements of trigonometry, elements of spatial Euclidean geometry, volumes.<br><br>On successful completion of this module, the student should :<br>• On successful completion of this module, the student should<br>• have profound knowledge of basic techniques in set theory;<br>• have knowledge and understanding of logical and deductive arguments;<br><br>• have profound knowledge of basic techniques in Linear Algebra;<br>• have knowledge and understanding of logical and deductive arguments;<br>• have knowledge and understanding of geometric relationships within the axiomatic structure of Euclidean geometry;<br>• understand and apply geometric properties and relationships;<br>• demonstrate capacity for finding rigorous proofs of small problems;<br>• understand and explain the meaning of complex statements using mathematical notation and language;<br>• understand the fundamental concepts of mathematical logic and should be aware of potential applications in computing.<br>• demonstrate skill in mathematical reasoning, manipulation and calculation by synthesizing geometric concepts into algebraic, functional, and problem-solving activities;<br>• understand and explain the meaning of complex statements using mathematical notation and language;<br>• understand and explain the relation of geometry to algebra and trigonometry by using the Cartesian coordinate and recognize geometric relationships in the world;<br>• ability to read and understand other books/papers using notions learnt by the course and undertsnd their applications. |
| **3** | **Course prerequisites** | For LOGIC the student must have the basic mathematical notions and methods as acquired in the secondary Schools. For GEOMETRY the student must know: Set Theory |

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| | | (language of set theory, the notion of function, graphs of fundamental functions, concept of sufficient and necessary condition), Numerical Structures (natural numbers, prime numbers, numerical fractions, rational numbers, basics of real numbers, inequalities, absolute value, powers and roots); Elementary algebra ( polynomials and operations on polynomials, identity, first- and second-degree equations); Algebraic Structures (Groups, homeomorphisms, rings); Linear Algebra: Linear systems, matrices, matrix operations, vectors and vector spaces, elementary operations on vectors, linear independence, bases, rank of a matrix linear transformations, determinants, inner product spaces, eigenvalues, and eigenvectors. |
| **4** | **Teaching methodsand language** | Lectures and Exercices<br>**Language**: Italian<br>**Reference textbooks**<br>• Paola Favro e Andreana Zucco, ***Appunti di Geometria Analitica***. Quaderni Didattici del Dipartimento di Matematica-Università di Torino. 2004.<br>• A. Asperti - A. Ciabattoni, ***Logica a Infromatica***. McGraw Hill, . 1997. |
| **5** | **Assessment methods** | Oral and written exam |