UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

General information		
Academic subject	**ALGEBRA 1**	
Degree course	Mathematics	
Academic Year	2	
European Credit Transfer and Accumulation System (ECTS)	8	
Language	Italian	
Academic calendar (starting and ending date)	1st period (27 September 2021 – 23 December 2021)	
Attendance	not compulsory	

Professor/ Lecturer	
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Department and address	Dipartimento di Matematica, 2nd floor, room 23
Virtual headquarters	Microsoft Teams – code: nceeadf
Tutoring (time and day)	By appointment: a virtual meeting on Microsoft Teams can be requested by e-mail.

Syllabus	
Learning Objectives	Acquiring a solid knowledge of algebraic structures
Course prerequisites	Basic concepts of set theory, including maps, relations, number sets
Contents	**Number sets:** The divisibility relation in , prime numbers. Euclidean division in . The GCD and Bézout's Identity, the Euclidean algorithm. The Fundamental Theorem of Arithmetic. Euclid's theorem on the infinitude of primes. The complex numbers as ordered pairs of real numbers, operations in , algebraic and trigonometric form, the *n*-th roots of a complex number, the Fundamental Theorem of Algebra. **Algebraic structures and homomorphisms:** Elementary properties of groups, Abelian groups, subgroups, cyclic groups and their generators, order of a periodic element, Lagrange's Theorem on the order of elements in a finite Abelian group. Elementary properties of rings, commutative rings, unit rings, invertible element, integral domains, division rings, fields, subrings, subfields. Rings of matrices. Direct product of groups and rings. Homomorphisms, monomorphisms, epimorphisms, isomorphisms, kernel of a homomorphism. **Polynomial rings:** Polynomials in one indeterminate, degree of a polynomial. Operations on polynomials. Polynomials with coefficients in an integral domain, the degree formula. Euclidean division in $K[x]$. The GCD and Bézout's Identity, the Euclidean division algorithm. Roots of a polynomial, Rational root theorem. Irreducible polynomials, factorization, associate polynomials. Algebraically closed fields. Gauss' Theorem and factorizations in $[x]$. Reduction modulo *p*, Eisenstein's irreducibility criterion. Irreducible polynomials in $[x]$ and in $[x]$.

	Quotient structures: The congruence modulo n in $\square$. The residue class ring $\square_n$. Linear congruences in $\square$ and linear equations in $\square_n$. The group of units of $\square_n$. The fields $\square_p$. The Euler function. The Chinese Remainder Theorem. Fermat's little Theorem, the Euler Theorem. The congruence modulo $f(x)$ in $K[x]$. The residue class ring $K[x]/f(x)$ and its units. **Symmetric groups:** The natural action of S_n on $X=\{1,...,n\}$. Orbits and cycles of a permutation. Decomposition of a permutation into disjoint cycles. Parity of a permutation, the alternating group A_n.
Books and bibliography	*Appunti di Algebra 1*, Giulio Campanella (Nuova Cultura) *Algebra*, G.M. Piacentini Cattaneo (Decibel- Zanichelli) *Elementi di Algebra*, S. Franciosi, F. de Giovanni (Aracne Editrice) *Algebra*, I.N. Herstein (Editori Riuniti) *Aritmetica e algebra*, D. Dikranjan, M.S. Lucido (Liguori Editore)
Additional materials	Material available on line: - Complete lecture notes - Exam sheets - Collections of exercises - Additional course material (historical notes, solved exercises, further remarks) uploaded to the Microsoft Teams platform https://www.dm.uniba.it/members/barile/homepage/algebra-n-1

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
70	40	30	100
ECTS			
8	5	3	
Teaching strategy	Blended learning: lectures and exercise sessions		
Expected learning outcomes			
Knowledge and understanding on:	○ Recognizing algebraic structures and their properties		
Applying knowledge and understanding on:	○ Solving algebraic problems by means of a structural approach		
Soft skills	• Making informed judgments and choices ○ Assessing the correctness of numerical results by reference to a conceptual framework • Communicating knowledge and understanding ○ Formulating definitions and abstract arguments in a formally rigorous manner		

	• Capacities to continue learning ○ Establishing logical connections between different topics

Assessment and feedback	
Methods of assessment	Written exam (3 hours, exercises) and oral exam
Evaluation criteria	• Knowledge and understanding ○ Logical reasoning and abstraction • Applying knowledge and understanding ○ Solving theoretical problems • Autonomy of judgment ○ Approaching notions in a critical way • Communicating knowledge and understanding ○ Mastering the algebraic language • Capacities to continue learning ○ Organizing knowledge
Criteria for assessment and attribution of the final mark	The grade (18-30) is assigned on the basis of an oral exam, after passing the written exam.
Additional information	