



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Algebra II

2021-2-E3501Q010

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#### Aims

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- Knowledge: The knowledge and the understanding of the principle definitions, theorems and results in the theory of rings and their modules, as well as in field theory.
- Capability: The capacity to apply this abstract knowledge to concrete problems in algebra.

#### Contents

Rings and their modules, and fields

#### Detailed program

Topics in ring theory. Polynomial extensions. Polynomials in several variables. Noetherian domains. Hilbert's basis theorem.

Localization.

Extensions of rings and fields. Algebraic and transcendental extensions. The splitting field of a polynomial. Finite fields.

Modules over a ring and linear algebra. Free modules: bases. Rank, universal property. Torsion. Modules over principal ideal domains: finitely generated modules; equivalence of matrices and reduction to normal form. Structure theorem for finitely generated modules. Torsion modules and primary decomposition. Invariant factors, elementary divisors. Applications to abelian groups and matrices: Structure theorem for finitely generated abelian groups. Canonical forms of matrices: the companion matrix, rational canonical form, Jordan canonical form.

## Prerequisites

Prerequisites: The contents of the courses *Linear algebra and Geometry* and *Algebra I*.

## Teaching form

6 credits (ECTS) of lecturing, 2 credits (ECTS) of exercise classes

## Textbook and teaching resource

N. Jacobson, Basic Algebra I, Freeman & Co, 1985.

Additional References:

S. Bosch, Algebra, Springer-Verlag, 2003.

B. Hartley & T. Hawkes. Rings, modules and linear algebra, Chapman & Hall 1970

## Semester

1<sup>st</sup> semester

## Assessment method

Examination: A **written exam** of ca. 90 minutes (non multiple choice) and an **oral examination** of ca. 20 minutes on the content of the course. Both exams contribute ca. 50 percent to the final mark. Passing the written exam (answering ca. 40 percent of all the questions correctly) is mandatory for being admitted to the oral examination.

In the first call the written exam will be divided into two partial exams. (The first before Christmas, the second after the completion of the course (around first of February)).

The questions will concern definitions, examples, counterexamples, exposition and application of Theorems as well as their proofs.

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## **Office hours**

On appointment

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