UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Elementary Mathematics

2223-1-F4001Q084

Aims

To introduce several classical and elementary results in Number Theory, Geometry and Analysis. Didactical aspects will be discussed as well as connections with other mathematical fields.
Each chapter of this course consists of

- Part A: the text of one or more conferences to high school students, concerning topics that may not be part of the current high school programs;

and

- Part B: a sequel and a deepening of Part A, at the level of a master degree in Math.

One of the goals of this course is to teach students how to prepare specific talks about innovative topics, possibly non contained in the high school programs, and to realize that they cannot avoid a serious deepening of these topics.

Students will be able to use part of this course for *Honors courses* in high schools.

Contents

Integer points. Polyhedra. Diophantine equations. Riemann sums.

Detailed program

- Integer points, polygons and polyhedra, linear programming.
- Simpson's paradox, Farey sequences, diophantine approximation.
- Frobenius' coin problem, partition, generating functions.
- Pythagorean triples and sums of squares, Minkowski's geometry of numbers.
- Benford's law, uniform distribution of sequences, normal numbers.
- Riemann sums and integrals.
- Appendix: remarks on Mathematics Education

Prerequisites

"Elementary" does not mean "simple". It means that there are very mild prerequisites. Here the first two years of undergraduate Math are enough.

Teaching form

Lessons.

Textbook and teaching resource

Detailed notes will be provided during the classes.

Further references:
M. Beck, S. Robins, Computing the continuous discretely. Integer-point enumeration in polyhedra. Springer (2015).
M. Bramanti, G. Travaglini, Studying Mathematics: The Beauty, the Toil and the Method, Springer (2018).
J. Sally, P. Sally, Roots to research. A vertical development of mathematical problems. Amer. Math. Soc. (2007).
G. Travaglini, Number Theory, Fourier Analysis and Geometric Discrepancy, Cambridge Univ. Press (2014).

Semester

Second

Assessment method

The student will be requested to understand all the contents of the course.
The exam consists of two parts.

1. The student has to hold a seminar on a topic of her/his choice (approved by the teacher). He/she will be evaluated considering her/his mastering of the chosen topic, as well as the teaching skills he/she will exhibit through the seminar.
2. An oral exam on the topics of the course. The student needs to master the whole programm and move

easily between different parts of Math.

Mark out of thirty, the exam is passed if the evaluation is at least 18/30. No midterm exam.

Office hours

By appointment.

Sustainable Development Goals

QUALITY EDUCATION