UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Methods of Applied Analysis

2627-1-F4002Q018

Aims

**Learning Objectives according to the Dublin Descriptors

**Knowledge and understanding

Students will acquire a solid understanding of the fundamental concepts, developed with logical and rigorous methods.

**Applying knowledge and understanding

Students will be able to autonomously and flexibly apply the acquired knowledge to solve exercises, mathematical problems, and basic applications, even in contexts beyond pure theory. They will develop appropriate techniques and problem-solving strategies.

**Making judgements

Students will develop the ability to critically analyze the concepts learned and to independently assess the logical consistency and correctness of definitions, theorems, proofs, and problem-solving methods. Personal reflection and the ability to connect different areas of Applied Analysis will be encouraged.

**Communication skills

Students will be able to clearly, rigorously, and effectively communicate theoretical content using proper mathematical and formal language, both in written and oral form. They will also be able to present the solutions of exercises and problems in a well-structured and justified manner, demonstrating mastery of mathematical vocabulary.

**Learning skills

The course will provide students with the conceptual and methodological tools needed to successfully tackle problems of applicable type. Independent and shared study skills will be fostered, together with a learning approach based on deep understanding, logical reasoning, and reflective practice in problem-solving.

Contents

Vehicular Traffic.

1. Macroscopic models: LWR and $2x2$ systems
2. Road networks: junctions, traffic lights, roundabout ...
3. Control problems: traffic lights timings, autonomous vehicles...

Detailed program

1. Modeling using partial differential equations.
2. Method of characteristics.
3. Hyperbolic conservation laws.
4. Numerical methods for conservation laws.

Prerequisites

Knowledge of basic courses of Analysis.
Banach and Hilbert spaces. L? spaces.

Teaching form

56 hours of in-person, lecture-based teaching (8 ECTS)

Course in English.

Textbook and teaching resource

- A. Bressan. *Hyperbolic systems of conservation laws: the one-dimensional Cauchy problem*. Vol. 20. Oxford University Press on Demand, 2000.
- L.C. Evans. *Partial differential equations*, American Mathematical Society.
- M. Garavello, K. Han, B. Piccoli. *Models for vehicular traffic on networks*, AIMS, 2016.
- R. J. LeVeque. *Finite volume methods for hyperbolic problems*, Cambridge University Press, 2002.

Semester

Second period.

Assessment method

Written examination: Students will answer questions covering the course content. Answers must be precise, detailed, comprehensive, and consistent with the topic.
Note: The instructor reserves the right to supplement the written test with an oral examination whenever the assignment of the final grade requires further clarification.

Office hours

By appointment.

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE | SUSTAINABLE CITIES AND COMMUNITIES