

Research-based Master's degree in Science and Technology

Major: Mechanics and Civil Engineering

Specialization: Mobilities in Mega-Cities (M2C)

Lyon1 University / ENTPE

<https://licit-lyon.eu/master-m2c/>

The Master 2 “**Mobilities in Mega-Cities**” is a one-year course designed for students who have completed a Master 1 in Science and Technology or a second year at an engineering school. The aim of this course is to develop specialized skills in the study of transport systems on an urban scale.

Training objectives

This Master's program trains experts in urban mobility who are able to:

- Design and evaluate efficient and sustainable transportation systems.
- Implement skills in data analysis, modeling, and management of intelligent transport systems.
- Address future mobility challenges, such as sustainable urban mobility, vehicle automation, and the integration of new mobility services.

Course Content

The Master's year is structured around four modules (about 300 hours of courses), fully taught in English, focusing on mobility modelling and data science for mobility, and complemented by a research internship.

- UE “Mobility Modelling” : 4 courses– 9 ECTS

These courses focus on mastering the dynamics of urban transport systems through the study of traffic theory and advanced simulation tools. Students will learn to analyze and optimize traffic flow, gaining essential skills to identify various traffic states and apply flow allocation principles. A multimodal approach emphasizes active transportation modes like walking and cycling, promoting sustainable mobility solutions. Topics include large-scale traffic dynamics, from road links to network-wide performance, and the exploration of micro-mobility systems, including rider-pedestrian interactions. Students will design innovative strategies for safer, more efficient shared spaces while leveraging dynamic simulation tools to evaluate and optimize multi-modal networks. This comprehensive training equips participants to transform theoretical insights into impactful, practical mobility strategies for the future of urban transport.

- UE “Mobility management and optimisation”: 3 courses– 9 ECTS

In these courses, students will explore the complexities of urban traffic management, focusing on the regulation and control of transport systems. They will delve into integrating fleets of connected vehicles (linked to communication networks), electric vehicles (tied to energy networks), and emerging mobility services like on-demand transport to optimize urban mobility. With an emphasis on addressing climate change, the curriculum highlights designing Intelligent Transport Systems (ITS) that harness Information and Communication Technologies (ICT) to create sustainable, multimodal, and cooperative solutions across diverse environments. Students will master the principles of multimodal network design, accessibility, and resilience, while investigating innovative strategies for future-ready urban mobility. The program also

equips learners with tools to quantify and mitigate transportation's environmental impacts, fostering sustainable transport solutions and contributing to global climate action. Through this comprehensive approach, students are prepared to revolutionize mobility, advancing systems that balance efficiency, sustainability, and adaptability in the face of contemporary challenges.

- UE “Data Science for mobility”: 5 courses – 12 ECTS

This teaching unit provides a comprehensive exploration of advanced data processing methods, focusing on both supervised (classification and regression) and unsupervised (clustering, dimensionality reduction) learning techniques. It covers the management of diverse data types, including quantitative, visual (images), and behavioral data, emphasizing their application in mobility. Students will uncover hidden patterns, build predictive models, and tackle real-world challenges through hands-on Python projects, leveraging powerful machine learning tools. The curriculum delves into advanced topics such as deep learning, graph neural networks, and discrete choice models to analyze preferences, predict demand, and develop data-driven engineering solutions. Students will also explore image and video analysis with techniques like CNNs and YOLO, applying them to impactful projects such as traffic sign detection. The program culminates in a collaborative, high-energy event where participants solve urban mobility challenges, showcasing their expertise in machine learning, deep learning, and simulation to innovate transportation systems.

- UE “Research Practice” 3 courses - 3 ECTS

This teaching unit provides students with an introduction to foundational research practices, focusing on key areas such as academic English, bibliographic research, and participation in scientific seminars.

- Research Internship (20 weeks) - 27 ECTS

Evaluation Methods

Evaluation methods vary across units (written exams, projects, reports, oral presentations) to assess both academic knowledge and its practical application.

Acquired Skills

- Ability to analyze and model complex transportation systems.
- Expertise in mobility data processing and analysis.
- Project management and communication skills.
- English proficiency and scientific literature comprehension.

Further Studies

Opportunity to pursue a PhD.

Career Opportunities

Graduates can work in a variety of sectors:

- Research (universities, government agencies, private companies)
- Engineering and consulting (engineering firms)
- Public administration (urban planning and transportation)
- Mobility start-ups