



M³ Multifunctional Metamaterials & Metastructures

Postgraduate Program (Master Universitario II Livello)

Objectives of the Program

- To train professionals with skills in analysis, design, analytical and computer modeling, simulation, and experimental validation in the field of **Multifunctional Metamaterials and Metastructures**
- To address theoretical/practical issues regarding
 - Theoretical foundations** of Metamaterials and Multifunctional Metastructures in various disciplines according to the physical phenomena of interest
 - Analysis techniques** of artificial materials and methods for their functional and logical characterization in **analytical and mathematical terms**
 - Large-scale **numerical modeling techniques of complex multifunctional structures**, also considering their multi-physical properties, through multi-scale techniques on **high-performance computing (HPC)** architectures and integration of hybrid approaches based on the use of **Artificial Intelligence**
 - Realization, implementation, and experimental characterization** in labs from a mechanical, electromagnetic, and structural viewpoint of multifunctional artificial materials
 - Cross-disciplinary applications** regarding multiple relevant scenarios, including the study of metamaterials and multifunctional metastructures in the **mechanical, structural, electromagnetic, energy, environmental and marine fields**

Grants and Opportunities

Fully-funded scholarships at:
<https://master-m3.unitn.it/grants>



Admission Requirements

- Those in possession of one of the following qualifications can apply to participate in the Master in "Multifunctional Metamaterials and Metastructures": (i) old system degree; (ii) master's degree or single-cycle master's degree; (iii) foreign qualification (Master Degree), recognized as suitable according to current legislation
- Applications for participation should be submitted exclusively online by **January 6, 2025 @ 12:00 (CET)**. More information at: <https://master-m3.unitn.it/admission>

The M3 Program

The Program includes a set of Standard Courses for a total of 42 ECTS (+10 ECTS of Lab Courses)

#	Standard Courses	H	ECTS
1	Foundations of Materials Science	15	3
2	Foundations of Electromagnetic Waves	15	3
3	Foundations of Mechanics and Acoustics	15	3
4	Foundations of Waveguides Propagation	15	3
5	Introduction to Multi-Functional Metamaterials	15	3
6	High-Performance Computing (HPC) for Multifunctional Metamaterials and Metastructures	15	3
7	Random Vibrations and Uncertainty Quantification for Metamaterials	15	3
8	Analysis and Design of Linear and Nonlinear Metastructures	15	3
9	Dynamics and Homogenization of Periodic Metamaterials	15	3
10	Advanced Modeling of Exotic Metamaterials	15	3
11	Hydrodynamic Metamaterials for Fluid	15	3
12	Metasurfaces and Metamaterials for Electromagnetic Wave Manipulation	15	3
13	Additive Manufacturing of Metasurfaces and Metamaterials (Automation and Controls)	15	3
14	Additive Manufacturing of Metasurfaces and Metamaterials (Technologies)	15	3
15	Topological and Mechanical Characterization of Metamaterials	15	3
16	Smart and Nano Metamaterials	15	3

2/4 Constrained Choice

Mandatory Courses

#	Lab Courses	H	ECTS
1	Lab on Design-based Materials Selection	15	2
2	Lab on AI-based Metamaterials & Metastructures Design	15	2
3	Lab on Additive Manufacturing of Metamaterials (Part I)	15	2
4	Lab on Additive Manufacturing of Metamaterials (Part II)	15	2
5	Lab on Metasurface Printing/ Manufacturing	15	2
6	Lab on Deployable Metamaterials	15	2
7	Lab on Metasurfaces for Smart Electromagnetic Environment	15	2
8	Lab on HPC for Multi-Functional Metamaterials and Metastructures	15	2
9	Lab on Advanced Computational Modeling of Mechanical Metamaterials	15	2
10	Lab on Product Design Fundamentals	15	2

5/10 Constrained Choice

The Courses include a combination of different teaching activities for a total of 1500 Hours

Activity Type	Hours	ECTS
Front lesson	210	42
Individual Study related to frontal lessons, including Self-Assessment sessions	808	
In-depth seminars and “hot-topic” tutorials	32	0
Lab activities (w/ Lab Coordinator)	75	10
Individual Study related to laboratory lessons, including Self-Assessment sessions	175	
Internship or Stage	150	6
Individual activity related to the Final Exam	50	2
Total	1500	60

Occupations and Fields of Activity

- Companies involved in the design, development, engineering, production, and operation of artificial materials and their applications
- Industries operating in the field of **mechanical** and **electronic** technologies for **avionics** and aerospace
- Industries operating in the field of **civil and environmental engineering** technologies, in particular in the fields of **anti-seismic and acoustic, thermal, and mechanical insulation**
- Industries operating in the design and development of both **terrestrial** and **space communications** and sensing systems;
- Industries operating in the field of **automotive** and next generation **land transport systems** technologies
- Companies operating in the **biomedical field** requiring skills for the development and use of systems based on artificial multifunctional materials
- **Materials engineering** companies
- **Research and development centers**, both public and private



Profile of the Study Program

- Degree: Postgraduate Program (Master Universitario II Livello)
- Language: English
- Duration: 1 year
- Period: Jan-Dec 2025
- ECTS: 60
- Fee: 3000 Euro

Read More

- M3 Website: <https://master-m3.unitn.it>
- DICAM Website: <http://dicam.unitn.it>
- DII Website: <http://dii.unitn.it>
- Coordinator: Prof. Andrea MASSA



Open Ceremony: Register Now!

Register at <https://master-m3.unitn.it/opening-day-registration> to attend the Opening Ceremony Day that will take place in hybrid format on **January 29, 2025** with Keynote Speeches of Prof. Nader ENGHETA (University of Pennsylvania) and Prof. Glaucio H. PAULINO (Princeton University).

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