

Entry Requirements and Preparation Guide

Master of Science in Intelligent Mechatronics Engineering

Department of Industrial Engineering | University of Trento

This guide helps prospective and newly enrolled students assess whether their academic background is suitable for the programme and identify any topics that should be reviewed before or during the first semester. It summarises the degree structure, the recommended prerequisite knowledge, the available support, and the self-evaluation test.

The degree programme

The Master of Science in Intelligent Mechatronics Engineering, offered by the Department of Industrial Engineering of the University of Trento, prepares engineers to understand, design, and implement complex, flexible, and innovative mechatronics systems with perceptive and cognitive capabilities. The programme combines mechanics, electronics, automation, and information technology.

Mechatronics engineers work in multidisciplinary environments shaped by digital manufacturing and the Industry 5.0 paradigm, where information and communication technologies are integrated into industrial processes and related services. Graduates therefore need a strong foundation in mechanical and electronic engineering, together with knowledge of machine learning, advanced optimisation, and control.

Programme structure

The first year is common to all students and develops the core knowledge required for mechatronic systems dynamical analysis, modelling and simulation, mechanical systems design, AI and embedded electronics together with automatic control. The students may choose to integrate their curriculum with relevant topics like signal processing, numerical optimization, precision systems and design methods. In the second year, students follow elective courses associated with one of the four curricula.

Mechanics

This curriculum focuses on the design of advanced, high-performance mechanical systems. It covers structural modelling, finite-element methods, and innovative materials, with applications in energy, space engineering and intelligent vehicles. Students develop advanced skills for designing high-performance mechanical solutions integrated into modern mechatronic systems.

Robotics and Intelligent Vehicles

This curriculum addresses the design and control of robotic systems and autonomous vehicles. It integrates perception, localisation, planning, dynamic control, and machine-learning techniques. Students learn to develop intelligent and cooperative robots and autonomous-driving systems.

Space Systems and Instruments

This curriculum covers the design of systems and instruments for space applications. Its integrated approach includes hardware design and qualification, sensors, data-processing systems, and on-board artificial intelligence. Students also study advanced measurement techniques, remote sensing, and space-mission design.

Electronics and Smart Energy Systems

This curriculum develops advanced knowledge of electronics, power systems and smart grids for renewable-energy integration. It covers microelectronic devices and sensors, hardware for energy conversion and management, smart grids, and intelligent IoT solutions, with a strong emphasis on design and laboratory work.

Recommended prerequisite knowledge

To follow the programme successfully, newly enrolled students should have a well-established background in the areas listed below. Students are encouraged to review any unfamiliar topics before classes begin and to address remaining gaps during the first semester.

Discipline	Recommended background
Calculus	Single-variable and multivariable functions; derivatives, including gradients, Jacobians, and Hessians; integrals; maxima and minima; ordinary differential equations; trigonometry; Taylor series; Fourier series; complex-number theory; fundamentals of the Fourier transform.
Linear algebra	Vector spaces; theory of linear systems; matrix operations; eigenvalues and eigenvectors.
Computer science	Fundamentals of computer architecture; data structures; data types; procedural and/or object-oriented programming, preferably in C, C++, or C#.
Physics	Kinematics and dynamics of particles and rigid bodies; Newton's laws; equilibrium of rigid bodies; Lagrange equations; conservation of energy; electromagnetism, including Coulomb's law, the Biot-Savart law, Gauss's law, and Maxwell's equations.
Statistics	Probability theory; discrete and continuous random variables, including probability density functions and cumulative distribution functions; functions of one or more random variables; statistical moments.
Circuit theory	Basic linear and nonlinear components, including resistors, inductors, capacitors, diodes, and transistors; Kirchhoff's laws; transformers and magnetic circuits; DC and AC circuit analysis under transient and steady-state conditions; the phasor method.
Industrial drawing	Applied geometry; geometric constructions and mechanical curves; orthogonal projections; European and American representation systems; axonometric and perspective projections; intersections between solids and planes; representation of mechanical parts and relevant standards; line types; sections in mechanical drawing.
Solid mechanics	Stress and strain; tensors and matrices; elastic constitutive laws and elastic constants; rheological behaviour; axial loading; transverse shear; bending and torsion in beams; internal-force diagrams; stresses and displacements in beams; static verification criteria.
Systems theory	Fundamentals of systems theory; state-space representation; stability criteria for linear systems; reachability, controllability, and observability; basic proportional, integral, and derivative control and PID controllers.

How to address gaps in your preparation

If you identify gaps in one or more of the areas above, you are strongly encouraged to take appropriate steps to fill them. You can use the following resources.

- Consult the recommended textbooks in the reference table below.
- Contact the lecturer responsible for the relevant course if you need more detailed guidance on its entry requirements or recommended reading.
- Attend the tutorial activities offered by the Department during the first semester. Tutorials in selected core subjects may also be available online through the link provided by the programme.

Applicants and prospective students should note that incomplete coverage of the recommended background does not prevent them from attending courses or taking examinations. The purpose of this guide is to help students prepare effectively and reduce difficulties during the programme.

Suggested references and contacts

Discipline	Books	Contact
Calculus and linear algebra	<ul style="list-style-type: none"> • W. Briggs and L. Cochrane, Single Variable Calculus, Pearson. • W. Briggs, L. Cochrane, and E. Gillett, Multivariable Calculus, Pearson. • S. Axler, Linear Algebra Done Right, Springer. 	Prof. E. Bertolazzi
Statistics	<ul style="list-style-type: none"> • U. Pillai and A. Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, Chapters 1-4. • C. Therrien and M. Tummala, Probability and Random Processes for Electrical and Computer Engineers, 2nd ed., CRC Press, 2011. 	Prof. D. Macii and Prof. D. Fontanelli
Computer science	<ul style="list-style-type: none"> • J. Wassberg, Computer Programming for Absolute Beginners, Packt Publishing. 	Prof. L. Del Prete
Physics	<ul style="list-style-type: none"> • K. Cummings, P. Laws, E. Redish, and P. Cooney, Understanding Physics, Wiley. 	Prof. D. Bortoluzzi
Circuit theory and electronics	<ul style="list-style-type: none"> • N. Storey, Electronics: A Systems Approach, 6th ed., Pearson, 2017, ISBN 978-1292114064. 	Prof. M. Brunelli and Prof. L. Pancheri
Industrial drawing	<ul style="list-style-type: none"> • C. H. Simmons, D. E. Maguire, and N. Phelps, Manual of Engineering Drawing, Butterworth-Heinemann. 	Prof. I. Cristofolini
Solid mechanics	<ul style="list-style-type: none"> • R. C. Hibbeler, Engineering Mechanics: Statics, Pearson. • R. C. Hibbeler, Mechanics of Materials, Prentice Hall. 	Prof. E. Rustighi
Fundamentals of automatic control	<ul style="list-style-type: none"> • K. Ogata, Modern Control Engineering, 5th ed., Prentice Hall, 2010. 	Prof. L. Zaccarian

Self evaluation test

You can use the self-evaluation test to check how well your current knowledge matches the recommended entry requirements. Before taking the test, please note that:

- the test is optional;
- it covers the disciplines listed in the prerequisite table;
- it is intended only as a self-evaluation tool for assessing your current preparation for the Master's programme; and
- results are recorded anonymously and processed only for statistical purposes.

Self-evaluation test <https://forms.gle/LCmFUFEbuKuZ3PKK9>