UNIVERSITÀ DI TRENTO
Department of Industrial Engineering

Mechatronics Engineering

Enrollment Prerequisites

Summary

The course

The Master of Science degree programme in Mechatronics Engineering offered by the Department of Industrial Engineering of the University of Trento aims at training engineers able to understand, design, and implement complex, flexible and innovative systems powered by perceptive and cognitive functions that require skills and knowledge of mechanics, physics, electronics, automation and information technologies.

The mechatronics engineer is supposed to work in a multi-domain working environment closely inspired and related to the Industry 4.0 paradigm, in which information and communication technologies permeate the manufacturing industry processes and the related services, causing a disruptive transformation in the design, production, marketing and dismission of goods.

For this reason, the graduates in Mechatronics Engineering have to master technologies, devices, systems and infrastructures for the industry of the future, reconciling solids foundations in mechanical and electronic engineering with basics in machine learning, advanced optimisation and control. Three curricula are currently offered, i.e.

- Mechanics;
- Electronics and robotics;
- Intelligent vehicles.

The first year of the Master of Science degree is common to all curricula, as it provides fundamental skills for systems modelling and simulation, digital signal processing, mechanical systems design, precision engineering, mechanical vibrations and automatic control. From the second year, Students shall attend mandatory and optional courses that are tailored to each curriculum.

Prerequisites

To attend the Master degree program proficiently, newly enrolled students should have a well-wstablished educational background in the topics reported in the following table.

Calculus	Single-variable and multi-variable functions derivatives (gradients, Jacobians, Hessian…) and integrals; unconstrained maxima and minima; ordinary differential equations; trigonometry; Taylor's series; Fourier's series; complex number theory; Fourier transform basics.
Circuit theory	Basic linear and nonlinear components (resistors, inductors, capacitors, diodes, transistors); Kirchhoff laws; transformer and magnetics circuits; DC and AC circuit analysis in transient and steady-state conditions; the phasor method.
Computer science	Computer architecture basics; data structures; data types; knowledge of procedural and/or object-oriented computer programming (preferably C/C++/C#).
Industrial drawing	Applied geometry; geometric constructions and mechanical curves; orthogonal projections; meaning and use of European and American systems for representation; definition of axonometries and perspectives; intersection solids/planes; representation of mechanical parts and related standards; meaning and use of line types; representation and use of sections in mechanical drawing.
Linear algebra	Vector spaces; linear systems theory; matrix operations; eigenvalues and eigenvectors.
Physics	Kinematics of particles and rigid bodies (position, velocity and acceleration in linear and rotational motion); dynamics of particles and rigid bodies (forces and moments, Newton laws of motion); equilibrium of rigid bodies; Lagrange equations; principle of energy conservation (work, energy and power); thermodynamics; heat transport (conduction, convection, radiation); electromagnetism (Coloumb's law, Biot-Savart law, Gauss law, Maxwell's laws).
Solid mechanics	Stress/strain definition; tensors and matrices; elastic constitutive law and elastic constants; rheorogical behavior; axial loading; transversal shear loading; bending and torsion in beams; internal loading diagrams; stresses and displacements of beams; static verification criteria.
Statistics	Probability theory; discrete and continuous random variables (probability density functions, cumulative density functions); functions of one or multiple random variables, statistical moments.
Systems theory	Systems theory basics; state space representation; stability criteria of linear systems; linear system properties: reachability, controllabilty and observability; elementary Proportional, Integral and Derivative (PID) controllers.

Actions to bridge the gap

The Students that feel to have some gap of knowledge in one or more of the disciplines above are warmly recommended to undertake proper actions to fill this gap. To this purpose

- a list of some possible reference books that could help Students to meet the minimum entry requirements to the Master's of Science Degree in Mechatronics Engineering is provided in the following table;
- if you need more detailed literature and/or clarifications on the entry requirements for a specific course, you can contact the lecturer of the course directly;
- during the first semester, the Department offers some tutorial activities to help Students to fill the entry gap of knowledge on some crucial disciplines. Some of these tutorials are also available online at this link.

Discipline	Books	Reference person
Calculus and linear algebra	• W. Briggs, L. Cochran, B. Gillet and E. Schulz: *Calculus, Single Variable,* Pearson; • W. Briggs, L. Cochran, B. Gillett and E. Schulz: *Calculus, Multivariable,* Pearson; • S. Axler: *Linear Algebra Done Right*, Springer.	Prof. E. Bertolazzi
Circuit theory and electronics	• N. Storey: *Electronics, A Systems Approach*, Pearson.	Prof. D. Brunelli and L. Pancheri
Computer science	• J. Wassberg: *Computer Programming for Absolute Beginners*, Packt Publishing Limited.	Prof. A. Del Prete
Industrial drawing	• C. H. Simmons, D. E. Maguire and N. Phelps: *Manual of Engineering Drawing*, Butterworth-Heinemann.	Prof. I. Cristofolini
Physics	• K. Cummings, P. Laws, E. Redish, P. Cooney: *Understanding Physics*, Wiley.	Prof. D. Bortoluzzi
Solid mechanics	• R. C. Hibbeler: *Engineering Mechanics, Statics*, Pearson; • R. C. Hibbeler: *Mechanics of Materials*, Prentice Hall.	Prof. E. Rustighi

Statistics	• A. Papoulis, S. Unnikrishna Pillai: *Probability, Random Variables and Stochastic Processes*, McGraw-Hill; • C. Therrien, M. Tummala: *Probability and Random Processes for Electrical and Computer Engineers*, CRC Press.	Prof. D. Macii and D. Fontanelli
Basics of automatic controls	• O. Katsuhiko: *Modern control engineering*, Prentice Hall.	Prof. L. Zaccarian

Perspective students should be aware that, even if the entry requirements above are not fully met, **they will not be excluded from courses and exams**.

Self-evaluation test

To check how well you meet the entry requirements, you can take the SELF-EVALUATION TEST.

Before taking the test, please consider the following:

- The test is not mandatory;
- The test is focused on the disciplines listed in the previous table;
- The test is just a self-evaluation tool to assess your current academic level on the topics of the Master of Science Program in Mechatronics Engineering;
- The results of the test are recorded anonymously and elaborated only for statistical purposes.

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