Master of Science in Technology, Industrial Digitalisation (InDi)

The Master's Programme in Industrial Digitalisation is an applications-oriented programme, which has been designed to keep pace with the accelerated developments in the transformation from traditional industry to the full-scale benefits of digitalisation. Digitalisation in industry means the integration of recent developments in telecommunication, distributed computations and storage (e.g. clouding), internet of things, cost-effective advanced computation devices, big data analysis, new effective artificial intelligence/machine learning algorithms, new IT applications, and other technologies to enhance e.g. the performance, efficiency, reliability, ecosystem, and cost-effectiveness. All sectors of life are going to be changed or impacted with the recent directions toward the digitalisation.

The InDi programme is built on strong foundations of mathematics, programming, and systems engineering. Although the program provides general abstract educational bases, the main application area is related to smart energy systems.

The Aim of Industrial Digitalisation Programme

The aim of the InDi programme is to provide high quality education with state-of-the art in digitalisation tools and technologies especially in the energy industry. The programme integrates different but strongly related topics like embedded systems (programming, architecture, security), intelligent robotics, evolutionary computing, artificial intelligence, machine learning, telecommunications, and automation. There are several courses as well as seminars to cover these topics and more. The program structure is flexible, and it allows the students to have plenty of choices in courses when planning their studies.

Energy and sustainable development is the focus technical area at the University of Vaasa. Energy systems have been continuously diverging from their old traditional centralised structure. There are many crucial reasons motivating and leading these changes, such as the expected reduction in the natural non-renewable or finite resources (e.g. coal, petroleum, and gas) due to large consumption, the huge accelerated global demands for electrical energy, and the climate changes due to serious pollution. Furthermore, modern information, computation, communication, and smart automation technologies have been substantially changing the structure of energy chains. Compared to their contemporary counterparts, future energy systems will be much more efficient, smart, reliable, and flexible. In order to function they need distributed automation (e.g. smart devices for active demand).

Some of the main objectives for the future energy systems are:

- High efficiency
- Use of renewable resources as much as possible (sustainability; requires distributed intelligence by embedded systems)
- Minimum environmental impacts (e.g. small pollution by intelligent process control)
- Self-healing and reconfigurable power networks (e.g. Smart Grids)
- Highest reliability with fast reaction for peak energy demands
- High secure.

The above objectives require a huge amount of data (technical as well as non-technical data), information processing, communication, and smart automation. The whole process should be adaptive considering the spatial-temporal dynamics with many uncertainties and to achieve the objectives in the most optimal way.

Learning Outcomes
Depending on the selected study courses as well as the thesis topic, the students who complete a Master's degree in the Industrial Digitalisation programme will learn to:

- Be familiar with the tools and technologies of industrial digitalisation.
- Use different machine learning algorithms in analysing, modelling and mining big data.
- Understand the main concepts of embedded systems in three levels: structuring, programming, and security.
- Demonstrate advanced computing technologies such as evolutionary computing and optimisation with applications in smart systems and intelligent robotics.
- Understand the main concepts of modern digital communication systems and their industrial applications.
- Write up-to-date and high-level scientific reports in different related areas such as wireless automation, embedded systems, wireless networking, etc.
- Be familiar with coding of some computing devices such as microcontrollers and FPGA.
- Be able to develop new mobile applications.
- Have strong scientific research skills; hence, you will be able to continue smoothly into PhD studies in any technical university or research institute.
- Present your ideas publicly and defend them in a scientific way.
- Work efficiently in groups as well as individually.
- Use high-level computer packages such as Matlab/Octave, Python, and/or R-Programming to simulate and emulate industrial systems as well as for data analysis.

Most of the seminars and theses topics are related to wireless communication, automation, smart energy systems, machine learning applications, and biotechnology; however, other smart applications for automation are also possible with the knowledge gained in Industrial Digitalisation, offering a flexible career continuation.

MASTER OF SCIENCE (TECHNOLOGY), MASTER'S PROGRAMME IN INDUSTRIAL DIGITALISATION

120 ECTS
Head of the Programme: Mohammed Elmusrati

COMPLEMENTARY STUDIES 30-31 ECTS

Mandatory courses (unless completed in the previous degree). NB! In addition, depending on your study background, some complementary courses may be assigned as mandatory. The courses are defined by the Head of the Programme and marked in the Personal Study Plan (PSP). The PSP is a compulsory document all students create with the guidance of International Education Specialist in the beginning of studies.

OPIS0039	Personal Study Plan	0
KENG9212	Writing Academic English	5
KSUO5111	Finnish for Foreigners I	5
(those who already master the basics of Finnish choose Finnish for Foreigners II or III, native Finnish speakers choose another language course)		
OPIS0025	Searching for Scientific Information 1	1
(former Information Skills I, if not completed in earlier University of Vaasa studies)		

At least two courses from the following mathematical courses:

MATH1240	Linear Algebra II	3
MATH2030	Numerical Methods (in Finnish with a possibility to complete in English)	5
STAT3120	Probability and Stochastic Processes	5
MATHC1210	Integral Transforms	3

Additional courses, enough courses to reach 30 ECTS must be chosen (in case mandatory courses make less than 30)

ICATC2140	Fieldbuses and Internet	3
ICATC2120	Wireless Networks	5
(Course not organised in the academic year 2018-2019)		
ICAT2020	Modelling of Digital Circuits	5
ICATC2130	Sensor and Control Technology	5
ISAN3020	Architecture of Complex Systems	5

or separately agreed/assigned courses

MAJOR STUDIES 40 ECTS

Make sure you fulfill any prerequisites a particular Major course may have.

Mandatory Courses (20 ECTS)

ICAT3120	Machine Learning	5
ICAT3160	Security of Embedded and Distributed Systems	7
ICAT3180	Applied Signal Processing	5
ICAT3020	C and Embedded C Programming	3

Major courses, choose enough courses to reach a total of 40 ECTS

ICAT3170	SoC-FPGA	5
ICAT3190	Special Topics in ICT and Automation (content varies)	1-5
ICAT3100	ICAT Seminar (content varies)	3
ICAT3090	ICAT Project Work	2-8
SATE3130	Smart Grid Communication	6
ICAT3110	Intelligent Robotics	5
ICAT3030	Computer Simulations	5
ICAT3010	Advanced Telecommunication Theory	8
ICAT3060	Energy Chains Optimisation	5
ICAT3070	Evolutionary Computing	5
ICAT3050	Embedded System Architecture and Design	5
ICAT3130	Mobile Application Development	5
STAT3150	R Programming	5

ICAT3990 MASTER'S THESIS AND MATURITY EXAM 30 ECTS

ICAT3995	Research Plan and Presentation	10
ICAT3996	Master's Thesis	20
ICAT3991	Master's Thesis Presentation	0
KNÄY300x	Maturity Exam	0

BUSINESS STUDIES (LIIKETOIMINTAOSAAMINEN) 14 ECTS

Mandatory for Finnish students, recommended for others.

Choose at least 14 ECTS from the following courses (in Finnish only):

ENER3070	Energiatekniikan projektityö 1-3	max. 20
ICAT3200	Tuotekehitys ja IPR	5
ORMS2020	Päätöksenteko epävarmuuden vallitessa	5
TITE2220	Introduction to E-business	5
TITE3270	Management of ICT Function	5
ISAN3040	Project Portfolio Management	5
ISAN3050	Service Design	5

Furthermore, such business studies, which are not included in another degree or in another module in the M.Sc. degree, can be included in the Business Studies module, for example management, organisational, marketing, accounting, finance, business law, economics, industrial management, business, international business or energy-related business studies.

Business studies can be completed in the abovementioned programmes at the University of Vaasa (note that there may be programme-specific entry restrictions) or as open university studies (the open university announces the selection of course units offered free of charge for degree students annually on their website).

The Business Studies module does not have to be completed if the M.Sc. degree includes a minor in business studies (for example management, marketing, accounting, finance, business law, economics, industrial engineering, business, business development, international business, energy-related business studies or other related minor).

OPTIONAL STUDIES (5–20 ECTS)

The students may choose these optional courses from any study programme of the University of Vaasa or from other universities

For Example:
ICAT3950 Practical Training 1–10 ECTS (The degree may include practical training / internship improving the student's professional expertise. A two-week (á 40 hours) training period is equivalent to 1 ECTS. The student must also write a report about the training.)

Recommended optional courses

OPIS0075	Applying for a Job in Finland	1
KSUO5112	Finnish for Foreigners II	5
KSUO5113	Finnish for Foreigners III	3
SATE2020	Energy Production	5
OPIS0026	Searching for Scientific Information 2	1
TITE2220	Introduction to E-business	5

Or other Mathematical, Automation, Energy, or Industrial Digitalisation courses

Note: Those Finnish students who have not completed studies in second national language in their previous degree, have to complete studies in second national language. These studies will be supplementary and not included in the degree.