Master of Science in Technology, Wireless Industrial Automation (WIA)

The Master's Programme in Wireless Industrial Automation is an application-oriented educational and scientific programme. The programme offers varied but strongly related subjects that are required for the modern and future industrial automation. The programme is built on strong foundations of mathematics, programming, and systems engineering. The main focus industrial application is related to smart energy systems.

The Aim of Wireless Industrial Automation Programme

The aim of the international Master's program in Wireless Industrial Automation (abbr. WIA) is to provide high quality education and research with a specialization in wireless automation in energy and related systems. With the new IP traffic based technologies of Internet of Things (IoT), the structure and the architecture of industrial automation are going for radical updates. The total size of IP traffic is expected to pass 2.3 zettabyte per year by 2020. What is more, wireless networks will handle two thirds of this total IP traffic. Number of wirelessly connected devices to the internet is expected to be more than 30 billion by 2020. Hence, modern wireless communication will be one of the key technologies for the future industrial automation in all benches. The Programme will fit the gap between wireless communication as a tool and its applications in industrial (mainly energy) automation.

Energy and sustainable development is the focus technical area at the University of Vaasa. Energy systems have been slowly diverging from their old conventional centralized structure. There are many crucial reasons motivating 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 the serious pollution. Furthermore, modern information, 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, 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 (including high energy efficiency computing with FPGAs)
- 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 and security systems

The above objectives require information gathering (technical as well as non-technical), information processing, communication, and optimum automated actions. The whole process should be adaptive to meet the spatio-temporal dynamics with uncertainties and achieve the objectives in the most optimal way possible. This could be defined as smart systems. Wireless communication is one essential part in this loop of smart systems as it enables the accommodation of distributed renewable energy generation, and it provides the platform for monitoring, operating, control, and protecting both renewable energy generators and power systems. In other words, wireless communication connects the different parts of energy systems. Together with computational intelligence it is one of the main tools for achieving distributed intelligence in energy chains. This indicates the critical importance of studying wireless networks and their interaction with modern digital automation and industrial systems.

The WIA programme provides the required knowledge as well as research activities in several related areas such as wireless automation with application in energy systems, wireless sensor networks, Internet of things (IoT), wireless platforms with strict QoS requirements, advanced communication techniques and its industrial applications, data fusion and data analysis, wireless networked control, and computational optimization of systems including smart grids, smart systems, machine learning, and so on. WIA is part of the multidisciplinary picture for energy research and development at the University of Vaasa.

Learning Outcomes

Depending on the selected study modules and the thesis topic, the students who complete a Master's degree in the Wireless Industrial Automation programme will:

- Have a strong knowledge and a comprehensive understanding of digital wireless communication and its roles in smart systems and applications in energy systems and industry in general
- Understand different advanced wireless communication systems, their structures, performance, applications, and theories behind them
- Build strong background on intelligent automation and computational artificial intelligence
- Understand how the communication systems are integrated with automation and computer systems, and how they are utilized in different data transfer situations, e.g. controlling energy production and transfer, in electronic payments systems, and e-business
- Evaluate, compare and select between communication systems or modify or develop new ones when needed for special purposes
- Be introduced to the design and programming of embedded systems
- Design communication systems/networks/platforms
- Work efficiently in groups as well as individuals
- Write professional and scientific reports
- Present ideas publicly and defend them in a scientific way
- Understand and be able to design future communication systems
- Have strong scientific research skills; hence, they will be able to continue smoothly into PhD studies in any technical university or research institute

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

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

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 course)

OPIS0025	Searching for Scientific Information 1 (former Information Skills I, if not completed in earlier University of Vaasa studies)	1

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
ICAT2020	Modeling of the Digital Electronics	5
ICATC2130	Sensor and Control Technology	5
ICAT3020	C and Embedded C Programming	3
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)

ICAT3010	Advanced Telecommunication Theory	8
ICAT3160	Security of Embedded and Distributed Systems	7
ICAT3180	Sound Processing	5

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
TITE3070	Analysis and Design of Human Computer Interaction	5
SATE3130	Smart Grid Communication	6
ICAT3110	Intelligent Robotics	5
ICAT3030	Computer Simulations	5
ICAT3120	Machine Learning	5
ICAT3060	Energy Chains Optimisation	5
ICAT3070	Evolutionary Computing	5
ICAT3050	Embedded System Architecture and Design	5
ICAT3130	Mobile Application Development	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, recommend for others.

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

ICAT3200	Tuotekehitys ja IPR	5
ENER3070	Energiatekniikan projektityö 1-3,	enintään 20
ORMS2020	Päätöksenteko epävarmuuden vallitessa	5
TITE3300	IT Services and Business	5
TITE2220	Introduction to E-business	5
TITE3270	Management of ICT Function	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
TITE3300	IT Services and Business	5

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