Program Description

Master in International Welding Engineering

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Decision taken by	Department board.
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This template for program descriptions was adopted by the Research and Education Board, HV 2022/508, 21 September 2022, editorial change 25 October 2022. Program description is a supplement to the program syllabus which is the legally binding document.

Background information[1]

Department and division	Engineering Science
Division	Division of Mechanical engineering
Name of Programme, Swedish	Magister i internationell svetsteknologi
Name of Programme, English	Master in International Welding Engineering
HE credits (number of credits)	60 Credits
Level (1st Cycle, 2nd Cycle)	2nd Cycle
Entry requirements, Swedish	Kandidatexamen, alternativt en till omfattningen motsvarande högskoleingenjörsexamen, i maskinteknik, tillverkningsteknik, industriteknik, materialteknik, marinteknik, eller motsvarande. Engelska 6 eller Engelska nivå 2.
Entry requirements, English	Bachelor of Science in Mechanical Engineering, Manufacturing Engineering, Industrial Engineering, Material Engineering, Marine Engineering or equivalent. English course 6 or English level 2 in the Swedish upper secondary school or equivalent.
Main field of study, Swedish	Produktionsteknik
Main field of study, English	Production Technology
Degree, Swedish	Teknologie magisterexamen med inriktning mot svetsteknologi
Degree, English	Degree of Master of Science (60 credits) with specialization in Welding Technology
Rate of study (full-time, part-time)	Full-time
Type of instruction (on campus, distance teaching)	Campus
Language of instruction (Sw., Eng.)	English

[1] The information found in the programme syllabus is legally binding and always takes precedence over the information provided in the description of the programme.

General programme information

The one-year master's programme with a specialization in Welding Engineering (60 credits) is designed to provide students with advanced theoretical knowledge and practical expertise in welding processes, metallurgy of metals, steel structure design, and quality control methods. Additionally, the programme offers the option to qualify as an International Welding Engineer (IWE), aligning with an internationally recognized qualification under the International Institute of Welding (IIW). This programme ensures that graduates are well-prepared to meet the evolving demands of the manufacturing industry. The educational training is closely related to University West's mechanical engineering research activities, specifically within Welding Technology (Svetsteknologi).

This University West master's programme in international Welding Engineering provides students with the theoretical knowledge and practical competencies to understand critical considerations and technologies encountered in welding. As such, the programme contributes to developing students' industrial skills, enabling graduates to aid the development of modern industry through mastery of welding processes and material science, Design of steel structures and knowledge of quality, productivity, and innovation. Comprehensive knowledge of such a key manufacturing technology as welding allows University West students to contribute meaningfully to the movement towards a more sustainable world.

As well as being in line with Swedish government policy on the transition to a sustainable industrial and social environment, the degree programme is consistent with the new research environment strategy (KAM-PT) to integrate learning with research. It ensures the linking of education with ongoing research activities, creating an environment where students can acquire up-to-date knowledge throughout their education from the bachelor to the PhD level. During their studies at master's level, students have the possibility to support ongoing research activities by contributing to the production of peer-reviewed scientific articles via thesis works, student projects, and participation in research projects. After completing the programme and acquiring a master's degree in welding technology, students will be strong candidates for further education towards a PhD degree in the areas of welding technology or production technology.

Programme contents, structure, and progression

Upon graduation, students earn both a master's degree and qualify to take an oral exam with the Swedish Welding Commission at a small extra cost, leading to an international qualification

in welding engineering (IWE). The programme specificity is the breadth of its syllabus. It provides theoretical knowledge and practical competence in welding technology that prepares highly qualified welding engineers and opens avenues to research.

This master's programme is designed to be completed within one year, divided into four 04 different learning periods. It combines core courses, laboratory-based practicals, project-based assignments, and industrial study visits to ensure a comprehensive and applied education. Figure 1 provides an overview of the programme's educational structure. The programme consists of 9 courses, of which 7 are dedicated to the International Welding Engineer (IWE) qualification. The remaining 2 courses are required to obtain the Master of Science degree in International Welding Engineering.

	Master's in International Welding Engineering			
	Q1	Welding Metallurgy of Iron-Carbon Alloys (6hp)	Conventional Welding Processes (7.5hp)	Ethics and Scientific Method (1.5hp)
	Q2	Welding Metallurgy of Advanced Materials (7.5hp)	Advanced Welding Processes (4.5hp)	Welding in Practice (3hp)
	Q3	Quality control in welding Applications (7.5 hp)	Construction and Design of Welded Components (7.5hp)	
	Q4	Master's Thesis		
	Summer			

Figure 1: Overview of the programme's educational structure

The research basis for the programme

The master's programme in International Welding Engineering is a step towards completing the educational cycle in Production Technology. Students can support research by contributing to producing peer-reviewed scientific articles through thesis works, student projects, and by taking part in ongoing research projects. The programme's subject area overlaps with the research areas of multiple well-established research units at UW, which aids cross-disciplinary collaboration and holistic knowledge development. Additionally, students graduating from the programme who wish to pursue a career in R&D in industry or in a research institute would be a very good fit for PhD studies in welding-related areas anywhere in the world. In this way, they can effectively contribute to producing peer-reviewed scientific articles on the one hand and stimulate the development of industries on the other, especially in areas like the automotive, shipbuilding, and aerospace industries.

The students are linked to the Engineering Department research group, which covers many research areas critical to welding technology. These include projects related to welding-based additive manufacturing and the weldability of materials used in electric vehicles. These research

areas are integrated into the proposed master's degree programme and linked to applied research projects.

The partner companies have contributed to the programme design by ensuring that relevant topics are covered. Students will gain direct knowledge important for working in an industrial environment. The companies will directly influence the quality of the programme by providing thesis topics.

The labour market, collaboration, and work-integrated learning[2]

Rapid market growth in various industrial sectors that require welding applications, as well as the evolution of advanced technologies in manufacturing, have resulted in a growing need for skilled welding and joining professionals. Studying welding engineering can support modern society's increased need for flexible and highly automated production. Studies on the Welding Engineering programme are founded on the needs of leading companies operating in this sector. Industry needs engineers who understand the complex technology related to advanced welding technologies, materials sciences, design of steel structures, quality control, and non-destructive testing. On graduation, students will be highly competitive for positions with industrial and engineering companies operating in the various fields of manufacturing or for further PhD studies in production technology in universities, research institutes and industrial R&D departments. The Welding Engineering master's degree qualifies students for positions like welding engineer**,** quality control engineer and project manager for design and development of new welding solutions in industrial companies in Sweden and internationally. Typical destinations for graduates include companies working in shipbuilding, aerospace, the automotive industry, steel construction, and pipe construction.

Throughout the programme, students engage with industry experts through workshops, seminars, and study visits. This direct contact with practitioners and academics doing research in the field allows students to discuss their understanding of welding-related topics and address questions to specialists. The international aspect of the programme favours communication and knowledge exchange between students from many nations and backgrounds, which adds realism to their experience in presenting their work orally and in writing. Hands-on work in different courses and the degree project offer great possibilities for students to practice and develop their skills with their classmates, faculty, company experts, researchers, and students from related programmes.

[2] Work-integrated learning is a pedagogical practice in which students' learning takes place through the integration of theoretical and practical knowledge and experience derived from an educational context within the framework of both higher education as a work environment and civil society.

The programme aims to cooperate with companies in the region and undertake close collaboration with universities with manufacturing and production programmes nationally and internationally. Consequently, students will be introduced to the latest best practices within welding technology, allowing them to acquire the skills essential for participation in research and development work and other qualified activities. The skills gained in the programme are put into practice and demonstrated in the research topic chosen for the degree project.

As the welding programme closely matches the research and development areas of University West in terms of the scientific approach to welding technology and employs the Work-Integrated Learning and cooperation education approach, it is designed so that the students learn in real working conditions at different stages of their studies. As a result, the students will be able to connect theory and practice. Moreover, the subject area of the programme overlaps with the research areas of several well-established research groups with multiple professors and senior researchers and several ongoing collaborative research projects in engineering science and the Primus research environment. The Industrial Placement course enables students to conduct a project in close collaboration with national and international companies in Sweden, Europe, Asia, South America etc. Based on our existing contact network with companies and businesses in the region and elsewhere in Sweden, several enterprises have been contacted as part of the creation of the programme and with a view to closer collaboration.

The programme's performance, e.g., course contents, will be investigated and evaluated by members of the programme board council. The programme board ensures that students are provided with the activities, training and facilities needed to achieve the intended learning outcomes. The programme board also collects viewpoints from students, instructors and external stakeholders, thus enabling everyone associated with the International Welding Engineering programme to participate in planning, implementation and evaluation.

Sustainable development

The master's programme is in line with the Swedish government's policy on sustainable development and the vision of the welding industry. The programme provides teaching, both theoretical and practical, that equips University West welding professionals with the knowledge and attitudes required to promote the transition to a sustainable industrial and social environment. Future welding aims to reduce the average cost of welding by one-third by providing improved process selection guidance, increasing the use of automation and robots, and lowering reject and repair rates. Other aims are to enhance the use of welding in manufacturing and construction operations by integrating welding with other

manufacturing technologies. Advancements in welding Engineering, along with the development of new materials, improvement in welding quality from the use of modern modelling techniques, systematic process selection and procedure development, and Non-destructive examination (NDE) technologies all contribute to a sustainable future. Above all, with improved knowledge of welding, students can effectively reduce energy use through productivity improvements such as decreased pre- and post-heating operations, the use of advanced lower heat input welding processes, and avoidance of over-welding. In total, the programme has a substantial ecological, economic, and social impact.

Students and applicants to University West should feel appreciated and welcome regardless of gender, gender identity, gender expression or sexual orientation, ethnicity, religion or belief system, disability, or age. All students in Welding Engineering have the same rights, opportunities, and responsibilities. Students will be treated equally during all the programme's teaching activities, group work, and practical laboratory work. During group and laboratory work, students work with different colleagues and in different groups to strengthen the bond between unit members and to promote collaboration across the whole unit.

Internationalisation

The programme is offered in English as an international education programme. Offering the programme to international students will enable increased internationalisation, allowing students to be in contact with a global environment and gain the soft skills usually found on an international exchange.
One challenge for the master's programme is integrating international students into Sweden and Swedish life. The number of Swedish Master's students is sometimes low in engineering, and this can cause limited socialisation for international students. By recruiting students from University West bachelor programmes (for instance, the Bachelor of Mechanical Engineering) and recruiting international students, we aim to create a global environment that is beneficial for both local and international students.

Other information

The programme, recognised by senior researchers as a missing piece of the education puzzle at University West, will be conducted in close cooperation with colleagues working in the research environment at the Production Technology Centre (PTC). This centre with its long-standing background in welding is a collaborative platform with a unique ecosystem of equipment relevant to welding technologies (friction stir welding, additive manufacturing processes, laser welding equipment, etc.) and ancillary processes. PTC has world-leading facilities, including thermal spraying facilities, machining (subtractive) equipment, and

measurement and control systems for in-situ monitoring and inspection. Most research projects at PTC address metallic materials such as steels, stainless steels, Ni-based superalloys, titanium alloys, and high-temperature metals/alloys. PTC is also equipped with advanced materials testing and characterisation laboratories to explore the process-microstructure properties performance of materials.

From a societal and technological perspective, long-term and sustainable planning, as well as relevant human development goals, are required to cover future needs for competence development. In addition, current job market statistics testify to the great need in society for this type of competence, as welding is a key technology in the manufacturing cycle. The programme aims to meet the increasing demand for welding experts of related markets and industries regionally and globally and bridge the current gap in knowledge and expertise resulting from the rapid evolution of advanced technologies and strong market growth.