



Programme Description

Master in Welding Technology

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Decision taken by	Department board
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Programme description is a supplement to the programme syllabus which is the legally binding document.

Basic data

Department	Institutionen för Ingenjörsvetenskap
Division	Avdelningen för svetsteknologi
Name of Programme, Swedish	Master i svetsteknologi
Name of Programme, English	Master in Welding Technology
HE credits (number of credits)	120
Level (1st Cycle, 2nd Cycle)	2nd Cycle
Entry requirements, Swedish	Kandidatexamen i maskinteknik, tillverkningsteknik, materialteknik, marinteknik, svetsteknik eller motsvarande. I utbildningen på grundnivå skall minst 15 hp matematik ingå samt 7,5 hp materialteknik. Engelska 6.
Entry requirements, English	Bachelor of Science in Mechanical Engineering, Manufacturing Engineering, Materials Engineering, Marine Engineering, Welding Engineering or equivalent. Additionally, the Bachelor of Science degree must be comprised of a minimum of 15 HE credits in mathematics and 7,5 HE credits material science. English course 6 in the Swedish upper secondary school or equivalent.
Main field of study, Swedish	Produktionsteknik
Main field of study, English	Production Technology
Degree, Swedish	Teknologie masterexamen i produktionsteknik med inriktning mot svetsteknologi
Degree, English	Degree of Master of Science (120 credits) in Production Technology 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

General programme information

Welding technology is a broad field covering areas from welding processes to materials science, and welding quality assurance to additive manufacturing. Domain knowledge of welding technology is in high demand in industries such as the aerospace, construction, and automotive industries, and more. University West's new and unique programme provides students with in-depth practical and theoretical knowledge, equipping them for the world of modern manufacturing.

The two-year master's programme in Welding Technology (120 credits) is combined with the International Welding Engineer (IWE) qualification training. It is also closely linked with University West's Production Technology research. By including the IWE syllabus in the programme structure, students will gain knowledge of different areas of welding production and study for two qualifications concurrently. After completing the master's programme and fulfilling the formal requirements of the IWE, students will be qualified to take an oral examination from the Swedish Welding Commission at a small additional cost, allowing them to gain the prestigious IWE certificate.

This University West master's programme 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, 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. In addition, it covers topics that are natural extensions of welding technology, such as additive manufacturing processes. Advanced materials science, phase transformation, process simulation and modelling, materials characterization and testing, fatigue and fracture mechanics, and non-destructive testing are covered in the curriculum (see Figure 1), giving students a broad skillset and research capability in these manufacturing areas. The program includes IWE courses such as (I) Welding Processes and Equipment, (II) Materials and their Behaviour during Welding (III) Construction and Design, and IV) Fabrication and Application Engineering. The programme starts with courses at the fundamental level and progresses to more advanced topics.

This combination of courses will give students a solid foundation in welding and allied technologies. Optional courses can be chosen from courses at UW or from internationally recognised institutions in production technology with the approval of the programme manager. An industrial placement course is included to allow collaboration with international companies located around Sweden. At the end of the programme, students work on a thesis project defined by a collaborating industry or research organization. The thesis project will thus prepare students for a career in industry or further studies as Ph.D. students or junior researchers. It is recommended that students have all relevant courses completed before commencing the thesis project.

Master in Welding Technology					
Year 1	Q3	Advanced Material Sciences (6hp)		Conventional Welding Processes (7.5hp)	Scientific Writing (3hp)
	Q4	Welding Metallurgy of Iron-Carbon Alloys (6hp)	Advanced Welding Processes (4hp)		
	Q1	Quality Control in Welding Applications (6 hp)	Welding in Practice (3 hp)		Fatigue and Fracture Mechanics (6 hp)
	Q2	Non-destructive Testing (4 hp)	Materials Charact. & Testing (3.5 hp)	Welding Metallurgy of Advanced Materials (7.5 hp)	
Summer					
Year 2	Q3	Additive Manufacturing Processes (7.5 hp)		Constr. & Design in Welding (7.5 hp)	
	Q4	Industrial Placement (15 hp)	Process Simulation and Modelling (7.5 hp)		Optional Course (7.5 hp)
	Q1	Thesis (30 hp)			
	Q2				

Figure 1: Overview of the programme's educational structure

The research basis for the programme

The welding master's programme in Welding Technology 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, including 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 learning¹

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 technology can support modern society's increased need for flexible and highly automated production. Studies on the Welding Technology 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, additive manufacturing, quality control, materials characterization, and non-destructive testing. On graduation, students will be highly competitive for positions with industrial and engineering companies operating in the various

¹ 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.

fields of manufacturing or for further Ph.D. studies in production technology in universities, research institutes and industrial R&D departments. The Welding Technology 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.

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 make sure 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 Welding Technology 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 technology, 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 Technology 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, as well as 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, and 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.