FINNISH EDUCATION
EVALUATION CENTRE

ACCREDITATION OF THE DEGREE PROGRAMME IN ELECTRICAL AND AUTOMATION ENGINEERING AT JAMK UNIVERSITY OF APPLIED SCIENCES

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FINEEC

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Description of the accreditation process and of the degree programme

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1.1 Aim of the accreditation

The aim of FINEEC's Engineering Programme Accreditations is to support the enhancement of quality in engineering degree programmes and to provide higher education institutions with the means of deciding whether an engineering degree programme provides its graduates with the academic qualifications necessary for a career in the engineering profession. The accreditation assesses the way an engineering degree programme is planned, delivered and developed to ensure that the students reach the programme outcomes and how the programme outcomes align with the reference programme outcomes set in the FINEEC Engineering Programme Accreditations manual. The reference programme outcomes describe the knowledge, skills and competencies that engineering students should have acquired by the time they have completed a degree programme in engineering. The accreditation evaluates the extent to which the set standards for programme's planning, implementation, resources and quality management are met.

1.2 Degree programme in Electrical and Automation Engineering

The Degree Programme in Electrical and automation engineering belongs to the JAMK University of Applied Sciences. JAMK UAS is located in Central Finland, having a main campus in Jyväskylä. The Degree Programme leads to a Bachelor of Engineering degree. Language of instruction is Finnish. The degree programme consists of 240 ECTS and intended study time for full-time studies is 4 years. Yearly intake is 60 students, including full-time and part-time students. Both full-time studies and part-time studies follow the same curriculum.

The degree programme has two specialisation areas as follows:

- Electrical Engineering
- Automation Engineering

1.3 The accreditation process

The accreditation was conducted in accordance with the principles set in the *FINEEC standards and procedures for engineering programme accreditation* document. The schedule of the accreditation was the following:

1. The accreditation team was appointed by the FINEEC Committee for Engineering Education on 1st November 2021.
2. JAMK University of Applied Sciences submitted the self-evaluation report on 22nd October 2021.
3. An online visit to the degree programme was conducted on 23–24 November 2021. The programme of the visit is given in table 1. The online visit was carried out by using Teams software.
4. Decision making meeting of FINEEC Committee for Engineering Education on 4th March 2022.

TABLE 1. Online visit programme

Online visit programme			
Tuesday 23rd November 2021		*Wednesday 24th November 2021*	
9.00–10.00	Presentation on the electronic evidence room (a Moodle workspace) for the accreditation team	09.00–09.50	Interview with the external stakeholders
10.15–11.15	Interview with the JAMK UAS and the degree programme management	10.05–10.55	Interview with the students
11.30–12.20	Interview with the academic staff	11.10–12.00	Interview with the alumni of the degree programme
13.20–14.10	Interview with the support services staff	13.00–14.30	Academic staff presented examples on the teaching and assessment methods (demos)
14.25–15.25	Questions on the recorded facilities tour directed to the degree programme staff, in particular laboratory engineers and project engineers	14.30–16.30	Accreditation team meeting: discussion on the initial findings and preparation of the initial feedback
15.40–17.00	Accreditation team´s meeting	16.45–17.30	Initial feedback for the JAMK UAS and the degree programme

1.4 The accreditation team

Chair of the team:
FH-Prof. **Andreas Posch,** FH Campus Wien University of Applied Sciences (Austria)

Team members:
University Lecturer **Veli-Pekka Pyrhönen,** University of Tampere (Finland)
Development Director **Veijo Pitkäniemi,** Stora Enso/Efora Oy (Finland)
Student **Alexandru Iliescu**, University of Timisoara (Romania)
Senior Evaluation Advisor **Kati Isoaho** from FINEEC acted as a project manager of the accreditation.

1.5 Evidence used in the accreditation

Self-evaluation report, along with the following appendices:

- List of Advisory board of Degree Programme in Electrical and Automation Engineering
- Advisory Board meeting notes
- Double-Degree mobility documents (transcript of records and personal learning agreement)
- Key figures of the programme
- Grade distribution
- JAMK common competences vs. EUR-ACE –Reference programme learning outcomes
- Department staff description
- RDI Projects concerning Electrical and Automation Engineering
- Publications Electrical and Automation Engineering
- Cooperation HEIs
- AVOP Feedback query results

- Accreditation team had access to the JAMK UAS staff intranet (including Moodle and Optima learning platforms) during the review process.

- Information gathered during the online visit within the interviews with the JAMK UAS and the degree programme management, academic staff, support services staff, current students, alumni as well as key stakeholders.

- The recorded video tour on JAMK UAS and the degree programme facilities, focusing on the laboratory premises.

- Evidence gathered by the degree programme for the electronic evidence room, which included course material, thesis works, project works and examples of course feedback, among other things. The evidence room was arranged as a Moodle software workspace. The accreditation team had access to the evidence room starting from 16th March 2021 as well as after the online visit.

Accreditation team requested the following extra materials from the degree programme: description of the role of the study modules in the degree programme structure, description of the laboratories in use, description of the course assessment methods in the degree programme, description of the online teaching and learning in the degree programme and description of the course-level feedback practises. In addition, the accreditation team requested the description of the key staff members in charge of the study modules.

Evaluation of the fulfilment of the accreditation standards

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2.1. Planning of the degree programme

> Standard 1: The programme aims, which describe the educational task and purpose of the programme, are consistent with the mission of the higher education institution and reflect the identified needs of employers and other stakeholders.

The Electrical and Automation Engineering degree program at JAMK aims at training students for two specialization options, which are Electrical Engineering and Automation Technology. Both education tracks are strongly oriented towards the needs of companies in the region of central Finland. The general aim of the degree programme is that the student acquires, based on the demands and development of working life, the necessary skills and knowledge for working in a professional specialist position. According to the self-evaluation report, the graduates can work as an electrical/automation engineer in the fields of industry, engineering, sales, technical support, education and services. Employers can be, e.g., engineering offices, factories, power mills, suppliers or graduates´ own businesses. Based on the interviews with the management and teaching staff, the need of having strong industry connections is clear for the whole degree programme staff. There is a strong interlink between the strategy of the regional council of Central Finland and the strategy of JAMK.

The degree programme aims are consistent with the JAMK students' strategic development programme 2021–2024, focusing on:

- New Generation Pedagogy
- Effective RDI activities
- Internationalization
- Quality Management
- Good working life connections

JAMK has defined six focus areas in its strategy: Bioeconomy, Innovative Learning, Tourism, Automation and Robotics (Rising/emerging Industries), Multidisciplinary Rehabilitation and Applied Cybersecurity. The Degree Programme in Electrical and Automation Engineering naturally has an important role in the Automation and Robotics focus area.

According to the self-evaluation report, the target of the degree programme is for the students to gain the following competences:

- Extensive basic practical knowledge and skills and their theoretical foundations for working in a specialist position in the field
- The ability to follow developments in the field
- Skills for self-improvement and continuous training
- Sufficient communication and language skills and
- Skills required for international activities in the field

The degree programme aims are reflected on regularly, always considering the future aspects for the corresponding professional field. Through regular meetings with industry partners in the Advisory Board (representing several important and big companies in central Finland), the degree programme management reflects the programme, including the necessary learning outcomes. The Advisory Board guarantees continuous dialogue and ensures that the degree programme can produce competent electrical and automation engineers.

According to the interview with the management, the Advisory Board members are sought through RDI cooperation with the local industry. In addition, the management stated that the selection of the Advisory Board always needs balancing between the continuation of the partnerships and on the other hand an on-going search for new partners.

The Advisory Board meets twice a year. The main purpose of the Advisory Board of Electrical and Automation Engineering is to create a common view for curriculum development. The Board investigates the programme´s educational and learning objectives. In addition, compliance with the structure of the degree programme, with the skill requirements of the industry, is assessed. The Advisory Board of Electrical and Automation Engineering drafts methods of cooperation between businesses and the educational community involving, e.g., excursions, practical assignments and projects, practical training and theses.

The Advisory Board has kept a workshop together with degree programme stakeholders and worked out a future expectation list for students and their skills. The interviewed external stakeholders were in general satisfied with the Advisory Board's work.

The management provided some examples of the changes made to the degree programme based on the feedback received from the Advisory Board. Since the degree programme curriculum was updated in 2020, a robotics component of 15 ECTS has been made available for the students. In addition, the topic of safety has been included in the studies as a designated course.

The interviewed external stakeholders highlighted the importance of general skills, such as teamworking and communication, aside from technical skills, when they recruit the new employees.

On teaching staff level, information exchange with industry partners is also in place, but in a more informal way, which should be integrated more strongly into the existing formal feedback loops.

Industry stakeholders are directly involved in the development of the degree programme aims. Public stakeholders, such as the city of Jyväskylä are consulted at the level of the UAS and the School of Technology. It was mentioned in the interview with the management that especially the city of Jyväskylä will be an important partner in the future. In addition to the structured feedback loops, there are several informal feedback possibilities. Especially smaller companies are involved indirectly through feedback during supporting graduate thesis projects, or via discussions and consultations with alumni. It could be beneficial to also include alumni in the Advisory Board, by usage of this current well-established structure.

According to JAMKs strategy, the Electrical and Automation Engineering programme has courses also available in the JAMK open university. This structure shows very well that the degree programme management clearly follows the JAMK overall strategy.

Overall, the degree programme aims are clearly identified and structures are in place to consider the needs of the major regional companies and the special needs regarding small and start-up companies. As the members of the Advisory Board are mainly from bigger and /or international companies, it would be good to consider adding presentative(s) from start-up or other smaller companies. Currently the feedback from alumni is mainly included through personal contacts between alumni and lecture staff and/or by visiting teaching alumni.

Based on the team's assessment, the degree programme meets Standard 1 fully.

Standard 2: The programme learning outcomes, which describe the knowledge, understanding, skills and abilities that the programme enables graduates to demonstrate, are consistent with the programme aims, with relevant national qualifications frameworks (if applicable) and with the FINEEC reference programme learning outcomes.

Based on the self-evaluation report along its appendices, the programme level learning outcomes are consistent with the overall programme aims. The programme level learning outcomes cover FINEEC reference programme learning outcomes and they focus mainly on Engineering Practice as well as Knowledge and Understanding.

The descriptions of learning outcomes in the degree programme in Electrical and Automation Engineering are based on international EUR-ACE reference programme learning outcomes. The programme learning outcomes have been divided to *common learning outcomes* and *professional learning outcomes*, respectively. The learning outcomes within both categories are given as lists of competencies as follows.

According to the self-evaluation report, the following four *JAMK common competences* are included in all bachelor's degree programmes at JAMK:

- Learning and information management competence
- Entrepreneurship, innovation and working community competence
- Internationalisation and communications competence and
- Ethical competence

The *professional learning outcomes* are entirely based on EUR-ACE reference programme learning outcomes, which are arranged under the following categories:

- Knowledge and understanding
- Engineering practice
- Investigations and information retrieval
- Multidisciplinary competences
- Communication and teamwork

Furthermore, JAMK have applied competence descriptions according to the European Qualification Framework and National Qualification Framework (EQF/NQF). The general attributes of all bachelor´s level graduates have been defined on the competence description of level 6 of the NQF. These are described in more detail in the principles of curricula included in the Study Guide. The Study Guide is publicly available on JAMK web site.

Because the Degree Programme in Electrical and Automation Engineering uses only EUR-ACE reference programme learning outcomes, the *JAMK common competences* have been cross-referenced in the appendix of the self-evaluation report, which shows EUR-ACE vs. JAMK common competencies in a matrix form. In this way, the degree programme has indicated the correspondence of JAMK common competences to that of EUR-ACE, which then helps the degree programme to use a single framework, i.e., the EUR-ACE reference programme learning outcomes. According to a self-evaluation report, the courses within the degree programme have been developed so that each EUR-ACE learning outcome category is covered.

The degree programme learning outcomes using EUR-ACE have been described in more detail on the JAMK web site. The programme level learning outcomes have been established in terms of what the student is able to demonstrate after graduation.

The degree programme key outcomes are described in a following way in the self-evaluation report as well as on the JAMK web site:

"The graduate has basic knowledge of natural sciences, mathematics, and technologies essential for achieving the goals of degree-related mechanical engineering studies. The graduates have knowledge and understanding of their own specialisation field and technology at a general level. The graduate can solve product-development or production-related problems that correspond to the level of knowledge and understanding achieved, which can also include aspects outside one's own specialisation field. The graduate can implement product-development or production-related plans corresponding to the achieved level in cooperation with multidisciplinary groups as well as apply research or other extensive methods to technical problems.

The graduate can apply the acquired knowledge and understanding in research to solve problems. The graduate can develop the practical skills needed and use their own judgement for decision making when developing products or production. The graduate is able to work on projects and communicate efficiently in various reference groups. The graduate can utilise both national and international networks and materials due to good language skills. The graduate has good communication and presentation skills. Finally, the graduate can develop one's own competences according to the principles of lifelong learning."

The programme learning outcomes and individual courses have been mapped together so that it can be seen which courses cover the EUR-ACE competences. Mapping is publicly available on the JAMK web site. Most courses are linked to the competences within Engineering Practice and Knowledge and Understanding, whereas there are less courses under Communication and Team-working, Investigations and Information retrieval, and Multidisciplinary competences.

The interviewed representatives of JAMK management stated that in future the most important reference programme learning outcome category for the degree programme will be Engineering Practice, because it covers most of the practical competences that are needed in working life. The large number of courses linked with the learning outcomes within Engineering Practice and Knowledge and Understanding are consistent with the programme aim, which is to produce engineers needed in practical engineering work in industry, engineering, sales, technical support, education, services and the public sector.

Based on the team's assessment, the degree programme meets Standard 2 fully.

> ## Standard 3: The course level learning outcomes, including thesis work and possible practical training, aggregate to the programme's learning outcomes.

The curriculum of the degree programme is well structured into the following main parts:

- Fundamentals (mathematics, physics, electrical, automation and information engineering)
- Major selection – Automation Engineering (software, hardware, systems)

- Major selection – Electrical Engineering (industrial electrical systems, electric power engineering)

- Special topics – Robotics, Electric building service systems, Future Factory (Elective studies)

- Research-based development in practice (bachelor's thesis, R&D)

FINEEC reference programme learning outcomes are explicitly mentioned in most of the courses, while there are also some courses that do not state them explicitly, but rather list competences under "Course competences" instead. There are differences in the concreteness and comprehensiveness of the competence descriptions. The target should be to harmonise them from quality point of view.

The description of the course-level learning outcomes in the self-evaluation report was very short. Especially this was evident when looking at the learning outcomes around Engineering Practise, considering the importance of this category in the Degree Programme in Electrical and Automation Engineering. Moreover, the report states that learning outcomes in Engineering Practice are included in several courses, but their meaning to the degree programme is described in a relatively narrow manner. It is recommended to further develop some of the course-level learning outcomes and to support the teaching staff to deploy them to students.

Knowledge and understanding are gathered throughout the studies. Out of 240 ECTS, 43 ECTS in twelve courses are related to natural sciences. Natural science skills are gained during the first study year in, e.g., Math3, Phys1 and Electrical Engineering1 .

The engineering basics are gained in many modules like Basic Skills In Information Technology, Basic Skills In Automation Engineering and Basic Skills In Electrical Engineering. In these modules and courses, the students build up knowledge and understanding of tools and engineering technologies.

All these courses set up, step by step, the necessary knowledge for the specific professional field, enriched with corresponding laboratory tasks.

Engineering Practice related learning outcomes are found in 38 courses within the degree programme. Although students choose part of these courses as required by the specialization area of Electrical Engineering or Automation Technology, the required learning outcomes of Engineering Practice will still be fulfilled. In addition, safety issues and environmental perspectives are also learned on practical courses.

Most of the Engineering Practice learning outcomes seem to be under Practice and Analysis, especially Practice. Analysis competences are learned on courses related to mathematics and natural sciences, whereas Practice-related competencies on lab-courses. According to the self-evaluation report, there are at least four different lab-courses that are directly related to Engineering Practice.

Investigations and information retrieval learning outcomes are addressed in many of the offered lecture courses. The research includes literature searches and correct interpretation of information retrieved from different sources (e.g. components data sheets, application notes, etc..) as well as measurements in the laboratory and the correct interpretation of this measurements. Also, the library offers trainings in the usage of electronic databases, which enhance the students' information retrieval competences and support students to efficiently work on their bachelor thesis.

In the bachelor's thesis, all these investigation and information retrieval competences are bundled.

The bachelor's thesis phase is divided into four parts:

a. Thesis planning, 3 ECTS, including information-seeking workshops, systematic information seeking and familiarization with source material independently. Writing and presenting a thesis plan and participating in small group and individual meetings. Management of agreements and necessary research permit issues.
b. Thesis writing, 2 ECTS.
c. Implementation: 6 ECTS including the empirical and functional phase, data collection and analysis. Participation in small group and individual meetings.
d. Thesis reporting and evaluation: 4 ECTS including thesis writing.

Additionally, there are investigation and information retrieval activities in lecture courses where students need to seek for technical documentations and select the relevant information out of this information to successfully pass the course tasks.

The multidisciplinary competences learning outcomes are gathered throughout the studies in 8 different courses. During the first year, students participate in JAMK InnoFlash. This course is a good example in which students are forced to work in a multidisciplinary group. They learn to gather and interpret relevant data and present their findings to the client. The Programmable Logic Controllers course, in which exchange students usually also take part, is a good example of teamworking and communications. A good example is also practical training, where the student gets practical experience as a member of the working environment.

In the English for Working Life and Swedish for Working Life language courses, the aim is for the students to find motivating ways to strengthen their language skills and develop ways of learning based on the principles of life-long learning in language studies.

Communication and team-working learning outcomes are found in 13 courses. Also, even if it is not specified in all the courses, this learning outcome is achieved in most of the courses that students follow during their study path. All the engineering courses set up the necessary knowledge for students to communicate with people from the same field in such a way that their ideas and opinions to be clear for everybody.

Besides the engineering courses, courses like JAMK InnoFlash are very beneficial for fulfilling these learning outcomes, taking into consideration the fact that students need to be part of a multidisciplinary team with which they need to find solutions for real challenges from working life. Also, for developing their communication skills more and more, students must follow some language courses in English and Swedish. These courses specialize in the language needed in the engineering professions.

Based on the team's assessment, the degree programme meets Standard 3 fully.

Standard 4: The curriculum gives comprehensive information on all the individual courses of the programme, including thesis work and possible practical training, and is accessible to students.

The whole degree programme curriculum is available on the JAMK website for the applicants, the students and wider audience. In addition, the detailed information on each course (incl. assessment criteria's) is available on the JAMK intranet for the degree programme students. This information also covers thesis work and three obligatory practical trainings along with the detailed descriptions.

The curriculum provides detailed course descriptions along with learning outcomes. All relevant information (such as ECTS credits, learning outcomes, course content, methods/ structure of teaching and learning, assessment methods) is defined.

Especially new students may not understand the course descriptions in a deep sense and also in the context of the whole study programme. Here it is very helpful that the study coordinator supports new students in finding an individual and good path through the study programme by considering existing knowledge and professional field experiences. The degree programme is recommended to continue its effort in guiding students especially at the entrance phase of the programme but also during the whole study path.

Based on the team's assessment, the degree programme meets Standard 4 fully.

Standard 5: The curriculum and the course timetable enable students to graduate in the expected time.

Based on the self-evaluation report as well as the information provided on the JAMK web site, the degree programme has designed the course selection and its implementation in a way which enables students to graduate in the expected time. The courses, practical trainings and thesis work included in the degree programme are arranged into the schedule which covers all the study years.

The programme coordinator makes a draft of course delivery for the next academic year every spring. The specific resource plan for each semester is prepared during the previous semester in cooperation with team leaders.

Documentation aimed for the students regarding the educational process, curriculum, and timetables are very detailed. This helps students to be aware of the practical details of the study process and follow the planned study path as supposed.

A specific course schedule is prepared for every course. The lecturer responsible presents the course schedule in the first contact teaching lecture. The students are also provided with an electronic version of the course plan and the assessment criteria in the virtual learning environment of each course.

Besides the schedules of the courses, for each one individually, some syllabus is created and presented to the students in the beginning of the courses by the respective teachers. Such action is very helpful since in this way students will know all the needed details about that specific course, namely:

- Content of the course
- Recognition of prior learning
- Attendance requirements
- Assessment criteria

For registering for a course, students use the student administration system (Peppi), applications that need to be done during the registration period. The teacher of the specific course will confirm the enrolment and will pay attention to give priority to the following classes, in the case that more students than the limit enrols to the same course:

- students of whose group the implementation is targeted at
- students for whom the implementation is compulsory
- students whose degree programme organises the implementation

In order to know how the course will be implemented and the specific details about it, it is mandatory for students to attend the first contact class, due to the fact that in that specific moment, the teacher will present everything that should be known for everyone to pass. Another important aspect is the fact that a course should be completed within two semesters or the student will need to start the course over from the beginning.

The statistics included in the self-evaluation material on the graduation time in the degree programme show that the degree programme has recently succeeded in increasing the portion of students who graduate in four to six years. In addition, JAMK has in general better graduation flow in electrical engineering and automation than the national average in the field.

Through the flexible structure of the degree programme, different types of current and future students are supported. For full-time students there exists a well-organized and structured time frame to successfully pass the degree programme. For part-time students, many of the courses are organized in a way to make study more flexible (e.g. many contents are available as well-structured distance learning courses) regardless location and timing.

In the interview with the current students there were some examples of students who graduated even faster than supposed. These examples confirm that the degree programme implementation allows both timely graduation as well as individual solutions.

Based on the team's assessment, the degree programme meets Standard 5 fully.

Standard 6: The criteria and process for student admission and transfer are clearly specified and published. Students should be informed of the qualifications necessary to enter the programme.

Based on the information gained from the self-evaluation report, interviews as well as the JAMK web site, there is criteria and a process for student admission in place in the degree programme.

Information related to the student admission process is publicly available for the applicants on the JAMK web site, such as:

- general entry requirements, incl. qualifications
- necessary documents that need to be submitted
- tuition fees, if it is the case
- admission of transfer students
- other relevant details about the admission

At this moment, the applications for the Electrical and Automation Engineering degree programme take place through the national application system. Even if the applications are on the national level, the role of JAMK is to select the needed number of students from the total that they receive, taking into consideration the details received alongside the list of applicants. Based on the interviews with the support services staff, the support services are very helpful for the admission process, so that everything functions as smoothly as possible. In the interview with the students, it was confirmed that all the needed information

about the admission process is easily accessible and, if some information was not clear, JAMK answered questions in the quickest time possible. Also, admission services attend to national trainings that are organized by the National Agency of Education on the details of the national admission system.

There are also transfer students who wish to change from one institution to another while completing their studies. The eligibility criteria that need to be fulfilled by the students in order to apply for such a transfer are presented on JAMK website, alongside the information about the admission criteria. Recognition of prior learning is part of the transfer process. Thus, there is also a process in place for transfer and information publicly available on it for applicants.

Based on the team's assessment, the degree programme meets Standard 6 fully.

Standard 7: Students are informed of regulations and guidelines that concern recognition of prior learning, progress of studies and graduation.

Based on the self-evaluation report and interviews, there is a process and guidelines in place for the recognition of prior learning.

Recognition of prior learning means that the knowledge that students already have can be recognised by JAMK, following specific regulations. All the information that is needed regarding this subject can be find on the JAMK website. At JAMK there are three ways of recognizing prior learning and experience:

- Accreditation
- Recognition of informal learning
- Studification

Depending on the case, there is a different process that needs to be followed by the students and the steps are described in detail on the JAMK website, such a way that the information can be easily accessed by the students, whenever they need it. The person that is responsible for giving guidance regarding this subject is the career tutor who can help the students with the process so that everything goes well. Of course, there are some cases when the applications are not approved, but this does not mean that everything stops there. Students can do a request for rectification and a second one if the first decision remains the same so that the evaluation can be done by another commission.

Interviewed students were well aware of the guidelines and process concerning the recognition of prior learning.

Based on the self-evaluation report and interviews with the teaching staff, there are several procedures for monitoring the progress of studies in the degree programme. Some of them are arranged in a manner which allows students to plan their studies together with the staff members and follow their own progress. The creation of the personal learning plan (PLP) for each individual student is integrated into the study courses. PLP is the students´ key tool for monitoring their own progress in the degree programme and setting goals during the study years. In addition, some of the teachers use electronic monitoring tools in the Moodle platform, which allow students to follow their own progress during the individual courses. Furthermore, JAMK follows the progress of the studies on the degree programme level on an annual basis as a part of its quality system. There is information available on the average graduation time within each of the degree programmes.

At the graduation moment, each student will receive a Finnish language certificate with a Diploma Supplement in English. These details are known by the students from the beginning, as they are publicly available on the JAMK website.

Based on the team's assessment, the degree programme meets Standard 7 fully.

Strengths, good practice and areas for further development regarding section 2.1: planning of the programme.

The team notes the following strengths and good practice in this section:

- The co-operation between the Advisory Board, the industry partners and the degree programme staff is well organised and implemented.
- The planning of the curriculum is well organised and involves both industry stakeholders as well as students. As a result of the planning process, the programme level learning outcomes are well formulated.
- The curriculum reflects the needs of Central Finland's business and industry and is updated regularly. Entrepreneurship and innovation have been identified as future matters.
- Schedules and timetables are well organised and support the achievement of the learning outcomes set for the degree programme.

The team sees the following as areas for further development in this section:

- It is recommended to also involve smaller companies in the Advisory Board.
- There are differences in the concreteness and comprehensiveness of the competence descriptions. The target should be to harmonise them from quality point of view.
- It is recommended to further develop some of the course-level learning outcomes and to support the teaching staff to deploy them to students.
- Generic competences, such as social skills, communication and team-working, could be communicated more clearly for the students on the activity level.

2.2. Implementation of teaching and learning

> Standard 8: The teaching and learning process, including the assessment of students, enables students to demonstrate that they have achieved the intended course and programme level learning outcomes. Students have an active role in co-creating the learning process and the assessment of students reflects this approach

JAMK has published guidelines regarding the common pedagogical principles of JAMK University of Applied Sciences as well as Ethical Principles. The pedagogical and ethical principles guide the design, implementation and evaluation of all the education provided by JAMK. Both documents are available on JAMK web site.

According to the self-evaluation report, the general principle in teaching and learning of the degree programme is student-centredness, which is in accordance with JAMK's Pedagogical Principles. The student is the owner of the learning process as well as responsible for it. However, in light of the interview with the external stakeholders, the concept of student-centredness is not well-known yet by the industry partners, even when they seem act according to principles which take the needs of the students well into account. The degree programme is recommended to raise discussion with the industry partners on this topic and jointly find ways to involve student-centredness explicitly in the cooperation and practical training practises.

All students create a personal learning plan (PLP) and a career plan at the beginning of their studies. The PLP helps students organise and evaluate the progress of their studies, clarify their interests, orientate their studies, and set objectives and schedules. Preparing for a career plan supports the understanding of work and study opportunities and making choices affecting their professional career.

The PLP is a mandatory assignment for the student in the course Development as an Expert. The PLP is based on the structure of studies described in the curriculum of the year of admission, and on each year's course offering. The students update their learning plans as their studies progress and their personal career plans develop.

The degree programme also offers possibilities for students to enhance their own learning process by students' own projects, and JAMK offers several facilities for such activities. These improve learning by doing and learning by working with real cases needed in practical engineering work. These also enable students to demonstrate achieved learning using concrete work.

Teaching and learning follow several different methods in the degree programme. The courses include lectures, case studies, group work, personal assignments and learning games. The versatile methods for teaching and learning enable students to demonstrate teamwork skills, report writing and investigation and information retrieval skills along with many other skills needed in working life.

According to the self-evaluation report, most of the courses introduce theory during the first lessons. Then students apply the theory on practical problems by exercises and larger assignments during the course. In some courses, assignments can be offered by companies, which aims to improve the commitment and motivation of students. Many courses use exams to test both knowledge and understanding, but there are also many assignments that are done in the laboratory and other settings.

There are a variety of teaching methods used in the course: lecture recordings, reserved contact hours for guidance and assistance, internet-based guidance hours, teaching materials on the web that guide students and provide step-by-step instructions, as well as help for smooth workflow. Electronic tools and platforms such as Teams, Zooms and Moodle are widely used. Furthermore, some courses seem to use progress monitoring tools that help students observe their own progress and get automated feedback on their performance.

According to the self-evaluation report, teaching methods are developed on the basis of course feedback and development proposals. The averages of course feedback is used as a quality measure. If the feedback average drops to a specific limit, the teacher will discuss the needed development procedures with the head of the department.

There were nine courses available for closer examination on the online visit: Functional Safety, Automation Systems 1, Phys1 Force and Motion, Programmable Logic Controllers, Logical Controls, Electrical Engineering 2, Research and Development, Production and Distribution of Electricity, and Electrical Engineering. A more detailed descriptions of these courses along with their teaching and learning methods were available on JAMK's Moodle platform. In addition, teaching staff members presented some of the courses for the accreditation team as samples of the degree programme offer in the demo session during the online visit.

In the courses, exams seem to be the most common assessment methods used, although the weight of exams significantly varies between the courses. In some courses, exams may constitute the largest part of the course assessment, whereas some courses have no exams at all. There is also the possibility of using online exams at JAMK, although interviewed teaching staff members stated that they choose this option only when it suits for the topic. Videos can be used as a part of the exams, even when the actual exam is a traditional one. Exams are usually replaced by different kinds of assignments that may be individual or group work assignment like laboratory work, reports, presentations, analysis and evaluation tasks, and other assignments. Most courses also display the number of total points required for each grade as well as the minimum points required to pass the course. Some courses also use minimum points for individual assignments, midterm exams and groupwork assignments that must be fulfilled before a student can pass the course. All-in-all, the grading policies are clearly indicated in most of the courses, and they are fair to all students. It also seems that learning activities are designed to support the intended learning outcomes, and the assessment methods are chosen accordingly.

According to the interviews with the teaching staff, the number of theses supervised annually by one teacher is not officially limited, although the typical amount is from 10 to 15.

Through study elements focusing on innovation and entrepreneurship (e.g. working in the Future Lab, during practical training in companies or working in R&D projects with JAMK staff and/or local industry partners), students get into close contact with the working life. Based on this, the students are familiar with the needs of bigger and/or smaller companies and can directly use this knowledge, after their graduation. Interviewed students and alumni greatly appreciated these opportunities.

It should be considered whether the possibility to work in the Future Lab, projects, etc. should on midterm be a fixed component of the degree programme.

Knowledge and understanding

- knowledge and understanding of mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme learning outcomes;
- knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme learning outcomes, including some awareness at the forefront;
- knowledge and understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations, in their specialisation
- knowledge and understanding of applicable techniques and methods of analysis, design and investigation, and of their limitations, in their specialisation;

The degree programme put strong effort into providing basic science and mathematics courses adapted to the engineering specialisation. The importance of mathematics, physics and electrical engineering, as a basis for any further engineering specialisation, is recognized and well implemented. During the first three semesters the focus is on building up the necessary mathematics, physics and basic engineering science knowledge (focus electrical engineering, fundamental of information technology and automation engineering). The courses and modules in the area of technical fundamentals are clearly and well-structured over the first three years of study.

The degree programme provides skills enabling the design of automation systems. After completing the degree programme, the alumni are familiar with the different levels of automation implementation in an industrial plant and know the related key processes of the industry.

They are able to plan and implement control systems and assess different alternatives for steering and adjustment solutions. The related study programme lecture courses are well designed to enable students to pass the requested tasks in time and build up the targeted knowledge.

Examples of these lecture courses (e.g. Logical Controls) were available in the electronic evidence room and proves the knowledge and understanding set up. In the online course, students are encouraged to build their knowledge through a step-by-step approach with continuously growing assignments.

Within the framework of research and development activities, the acquired knowledge can be applied to solve actual problems of the industry. This strong interlink between the study program and the industry partners is a major benefit for the students and their knowledge and understanding set up. Most of all the bachelor's theses are done in a defined framework together with industry partners. This gives students the opportunity to demonstrate their knowledge in research and development activities and is in many cases the first step into the professional field.

Engineering practice: analysis, problem-solving, design, practice

Analysis
- ability to analyse complex engineering products, processes and systems, and to correctly interpret the outcomes of such analyses, by being able to select and having the practical skills to apply relevant established analytical, computational and experimental techniques and methods

The curriculum is divided into two study tracks: Automation Engineering and Electrical Engineering. The students are trained to analyse complex engineering systems as well as correctly interpret the outcome of such analyses. Through different well-defined tasks, students accumulate the necessary practical skills.

The students are able to select relevant methods for problem analysis, build appropriate models for problem solving and verify these solutions using computational and experimental techniques.

Interviews with industry partners indicate that the expected skills of graduates are fully met.

Analysis skills are practiced e.g., in the Electrical Engineering Laboratory Work course, where students learn to analyse direct current and alternating current circuits and apply theory to practice. Also, Electrical Engineering 2 helps students to learn the fundamental modelling techniques of electrical engineering and to learn systematic analysis methods for direct current and alternating current circuits. Electrical Engineering is evaluated using two mid-terms and the students can earn extra points by doing homework.

Overall, problem solving is convincingly covered by the degree programme, and this applies in particular to practical problem solving. Well-equipped laboratory facilities including programming tools are used and training is provided on them during the degree programme, as well as e.g. through a course on Electrical Engineering Laboratory Work, Hardware Engineering Laboratory Work, Electric Power Engineering Laboratory Work and Robotics Laboratory Work.

Project work in laboratories trains practical problem solving in a convincing manner. Students learn to measure and install devices and systems according to needs. Experimental techniques and methods could be strengthened further by more advanced and more intense laboratory training.

This would also support analytical skills and teach the importance of the safe way of working, including relevant knowledge on electrical and automation systems. The equipment available for the degree programme students is excellent and the teachers and other staff members around it are very motivated and competent.

The design perspective of Engineering Practice can be found e.g., in the course Functional Safety. The course helps students to understand basic concepts of functional safety and to develop understanding of what functional safety means as part of automation design. Students recognize different stages of design and their interdependencies along the whole design process. Also, students get a clear view of what kind of information is available at each design stage and what is produced as an outcome of each stage. The course is evaluated using three exercise works, one pass–fail laboratory work and a final exam. Half of the points can be obtained from the exercise works and the other half from the final exam.

The design skills of Engineering Practice can also be found e.g., in the course Production and Distribution of Electricity. Students learn how to model power and energy losses as well as form equivalent circuits and circuit reduction techniques.

Practice
- ability to apply norms of engineering practice in their engineering specialisation;
- ability to consult and apply codes of practise and safety regulations in their engineering specialisation

Engineering practice is considerably dealt with in most courses. There are many real engineering cases within the studies and many laboratory activities in such courses as Electrical Engineering Laboratory Work, Hardware Engineering Laboratory Work, Electric Power Engineering Laboratory Work and Robotics Laboratory Work. Very well available and equipped laboratory facilities support the achievement of the practical learning outcomes.

Practical training is obligatory for all the degree programme students, which allows them to train the skills and competences gained in the studies in a real working environment.

The degree programme has recently done special work in the development of teaching and learning safety matters in their field. In addition to the training provided as a part of the laboratory assignments, there is also a designated course for this topic in the degree programme. Thus, all these efforts together provide a good basis for achievement of the learning outcomes related to the codes of practice and safety regulations.

Several courses in the curriculum provide project work, study tours or visiting lectures in real company environments. All the final theses are also normally done on real problems provided by the industry partners. All these features provide students possibilities of achieving the learning outcomes that correspond for applying the norms of engineering practice in their specialization.

Investigations and information retrieval

- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, and to carry out simulation and analysis, in order to pursue detailed investigations and research of technical issues
- ability and practical skills to design and conduct experimental investigations, interpret data and draw conclusions
- ability to work in a laboratory/workshop setting

Students are trained to search for practical solutions and to consult the literature, databases, professional journals and perform searches on the internet. They have access to standards and relevant databases, e.g. IEEE and material which is necessary for their laboratory work.

The library staff also contributes to the achievement of the learning outcomes in information retrieval. Structural trainings are offered by the library staff to support the students in their information retrieval process. Passing this process enhances the information searching and retrieval competences of the students in parallel.

In general, the studies offer versatile possibilities to gain the competences needed in working in laboratory settings. Laboratory training is included in several courses, including guided work and individual work. According to the interviewed students, some laboratories can be used 24/7, which enables each student to gain as much as possible out of his/her practical laboratory experience.

DCS (distributed control systems) and PLC (programmable logic controllers) portals/systems could be used also remotely, which gives as much flexibility as possible to the students. Through this structure, students are trained in self-organization and their self-learning competence, adaptable to their available time slots. They are well supported/coached by dedicated laboratory staff. This special laboratory staff is available for questions and support the students to successfully pass the different laboratory tasks.

Additional to the laboratory trainings, students can also work on the R&D projects of JAMK and/or on R&D projects with industry partners, in special R&D laboratories. In this case, the students are supported and guided by designated project staff members.

The bachelor's thesis quality shows best the result of all efforts made to establish the necessary skills in investigation and information retrieval. Examples of bachelor's theses were available in the electronic evidence room for the accreditation team. Most of the bachelor's theses are written on specific topics/problems of industrial partners, which need to be investigated and/or solved. The bachelor's theses are well structured and related literature is summarized correctly. In any case it is recommended to use actual scientific reports (e.g. IEEE), scientific publications or technical report of components) especially as background information (e.g. with references to state of the art solution approaches) related to the focus of the bachelor's thesis more often.

Multidisciplinary competences

- awareness of the wider multidisciplinary context of engineering
- awareness of societal, health and safety, environmental, economic and industrial implications of engineering practice and recognition of the constraints that they pose
- awareness of economic, organisational and managerial issues (such as project management, risk and change management) in the industrial and business context
- ability to gather and interpret relevant data and handle complexity to inform judgements that include reflection on relevant social and ethical issues;
- ability to manage complex technical or professional activities or projects, taking responsibility for decision making
- ability to recognise the need for and to engage in independent life-long learning
- ability to follow developments in science and technology

Electrical and automation engineering is by definition a multidisciplinary field. By analysing the curriculum and basing an assessment on the opinion of the alumni and students, it is clear that the learners are aware of the implications of engineering practice in a multidisciplinary work environment. Moreover, common courses for all JAMK students, such as the Innoflash and Entrepreneurship courses, allow the students to solve problems and make decisions as part of a multidisciplinary team.

A good example is also practical training, where the student gets practical experience as a member of the working environment. Companies can advertise available vacancies (training or thesis) in the Teams channel where all the electrical and automation students are members. Overall, in all projects, students gain the ability to communicate and work as team members in communities of students and companies. The students get motivation to further their language skills and ways of learning based on the principles of life-long learning in such language course as English for Working Life and Swedish for Working Life.

Especially within the broad basic training, the students are learning skills for life-long learning in the engineering field. It would be useful to provide each student with more in-depth knowledge in one elective topic so that they are also trained to take individual responsibility, and to also become individually specialized, e.g. in robotics, electricity networks, or a hardware engineering or power engineering technique.

This would support them in identifying and developing a personal strength or preference already before they choose a final bachelor's thesis topic. Such technically oriented strength development could be reached through individual project work and seminar presentations, possibly in direct connection with the existing advanced courses of the degree programme and possibly as a way of implementing more "inverted class" teaching also for in-depth technical aspects of automation and electrical engineering.

- ability to communicate effectively information, ideas, problems and solutions with the engineering community
- ability to communicate effectively information, ideas, problems and solutions with the society at large;
- ability to function effectively in a national and an international context;
- ability to function effectively as an individual and as a member of a team;
- ability to cooperate effectively with engineers and non-engineers.

In general, the degree programme provides a great deal of opportunities to develop one´s team-working skills. Several courses include teamwork and assignments to be completed in the teams. The thesis phase also includes small group meetings.

Practical trainings and assignments provided by the industry partners develop students´ skills to communicate in different environments, both with the engineers and non-engineers. The InnoFlash course, which gathers together students from all around JAMK, also offers possibilities to develop one´s communication skills in a multidisciplinary context.

There is to some extent heterogeneity in the achievement of the learning outcomes in internationalization among the degree programme students. The degree programme has a double-degree agreement with Esslingen University of Applied Sciences in Germany. However, the number of students joining this activity is not very high so far. The number of double-degree students graduated from JAMK since 2015 is 21 students (11 Mechanical Engineering and 10 Electrical and Automation Engineering), and from Esslingen University of Applied Sciences 12 students (10 Mechanical Engineering and two Mechatronics). In the academic year 2020 – 2021, three Mechanical Engineering and seven Electrical and Automation Engineering students from JAMK, and two Mechanical Engineering students from Esslingen University of Applied Sciences studied double-degree studies, and they all will graduate in two years.

There are also efforts for advancing internationalisation at home. The Industrial Engineering department organises summer school courses at JAMK where students from both from JAMK and partner universities participate. The teachers also represent both parties. Part of the courses available are taught in English, which also serves acquiring international skills and competences in the studies. In addition to the obligatory language courses, it is possible to include optional language studies in the personal learning plan (PLP).

The degree programme is encouraged to continue its efforts to increase the number of students in the double-degree studies as well as wide involvement in internationalization at home.

Based on the team's assessment, the degree programme meets Standard 8 fully.

The team notes the following strengths and good practice in this section:

- Student-centredness is at a good level and well taken care of in the terms of achievement of learning outcomes.

- The InnoFlash course, which allows students to work in multidisciplinary teams and gain skills needed in working life.

- Working-life competences are reflected by the students, including life-long learning competences.

- A large variety of teaching and learning methods and practises. The use of digital tools is well implemented.

- Excellent laboratory facilities and support as well as engineering practice related studies, such as laboratory work and assignments.

- Safety is defined as an important topic, a course on functional safety as a good example.

The team sees the following as areas for further development in this section:

- Final exams as well as mid-term exams are the most common ways to assess students. It is recommended to further extend the variety of assessment methods.

2.3. Resources

Standard 9: The academic staff are sufficient in number and qualification to enable students to achieve the programme learning outcomes. There are arrangements in place to keep the pedagogical and professional competence of the academic staff up to date.

The academic staff of the degree programme consists in total of 11 staff members (team leader, head of the programme, one principal lectures, 5 senior lectures, one lecturer and two project engineers). Additional personnel support laboratory activities (two persons) and the team leader in applied research activities.

The CVs of the staff members were examined as part of the review process. Senior lectures must have a master's degree and additional pedagogical qualification of min. 60 ECTS. A principal lecturer must have at least licentiate degree and also a pedagogical qualification of min. 60 ECTS. Support staff for the laboratory must have a bachelor's degree.

According to the interview with the management, the role of the principal lecturer in the degree programme is to some extent wider than lecturers. A principal lecturer may focus on the master´s degree teaching and learning, as well as connect more deeply with the RDI activities.

Additional to the fixed academic staff, there are visiting lectures (e.g. from industry partners, alumni's or lectures from abroad).

Based on the self-evaluation report, materials in the electronic evidence room, as well as the interviews, the teaching staff are highly skilled professionals with a background in industry, in the relevant professional fields.

The composition of the academic staff fits the need of the degree programme and serves its two specialisation tracks (Electrical and Automation Engineering), too.

The mid and end term feedback collection enables the lecturers to enhance and adapt lecture courses. In the future it would be wise to involve the students in the discussion on the lecture course adaptions, additionally to the current feedback collection process.

The COVID-19 situation has accelerated the usage of distance learning structures and tools, including the change to new didactical methods for this digital learning environment. Interviewed teaching staff members noted that there is support available for the implementation of the distance learning. For instance, there has been short trainings available on the use of Moodle as well as designated support persons for individual guidance.

Professional competence education and trainings or other further development measures are discussed and agreed with the degree programme management on an annual basis. Interviewed teaching staff members confirmed that they have the possibility discuss their training needs with their superiors and e.g. to get funding for teacher exchange periods at the partner universities. Furthermore, support services carry out an annual survey on the quality of their services. This is one of the channels for the teachings staff to communicate their needs inside JAMK.

Based on the team's assessment, the degree programme meets Standard 9 fully.

Standard 10: An effective team of technical and administrative staff supports the programme. There are arrangements in place to keep the competence of the support staff up to date.

Study admissions, library services, international services and ICT services are centralised and serve the whole JAMK. Technical staff, such as project engineers and laboratory engineers, are part of the employees in the Industrial Engineering Department.

From an organizational point of view, these project and laboratory engineers are part of the Department of Industrial Engineering and support the study programmes Energy and Environmental Technology, Mechanical Engineering and Electrical and Automation Engineering.

On the JAMK website all project and laboratory engineers are mentioned and accessible via email and by phone.

Through the online visit and the reviewed material, the available technical IT support and all other central services have been perceived as very customer oriented. This was also pointed out by the interviewed students during the visit.

Training and continuing education is defined during the staff appraisal or initiated by changes in the student's admission process, through the management of the degree program. All these activities guarantee that the whole support staff is up to date and do best their daily work.

All different support service groups are in continuous exchange with similar functions and groups in other universities and UASs (e.g. the admission services participate on special trainings organized by the National Agency for Education).

The Engineering Department has its own study coordinator. This study coordinator is responsible for administrating the personal learning program (PLP), which has been agreed between the degree management and each student. The role of the student coordinator is essential to enable PLPs for each student, based on the recognition of prior learnings/experience and the requested learning outcomes.

As mentioned in the self-evaluation report, the project engineers and the laboratory engineers have to have a bachelor's degree or equivalent education. In the online visit it has been pointed out that the project engineers support the R&D activities of the degree programme, together with industrial partners. Examples of currently running R&D projects are: coADDVA – ADDing value by computing in manufacturing, Power grid protection RDI environment, iADDVA – Adding value by creating industry platform, etc. The full-time teaching stuff is currently supported by nine project engineers and six laboratory engineers. They guide the students in the laboratory setting.

Students are well supported/coached by dedicated laboratory engineers. These special laboratory engineers are available for questions and support the students in successfully passing the different laboratory tasks.

For safety reasons (e.g. electrical engineering laboratories, etc..), some of the laboratories are only usable together with the related laboratory staff. The practical training in these restricted access laboratories is well organized (group size and time slots) to guarantee the finalization of degrees in time.

In addition to the laboratory training, students can also work on the R&D projects of JAMK and/or on R&D projects with industry partners, in special R&D laboratories. In this case, the students are supported and guided by special project staff members.

This overall support by the support services is appreciated by the students and guarantee reaching the intended learning outcomes.

Based on the team's assessment, the degree programme meets Standard 10 fully.

Standard 11: The students are provided adequate and accessible support services to enable the achievement of the programme learning outcomes.

At JAMK there are both centralised and programme specific support services for students. The support services that work in a close collaboration with the students are:

- library services
- admission services
- study affair services
- international services
- study coordinators services
- career tutor's services

The key factor of success for the support services is close collaboration with the students, along with the customer-oriented attitude. Interviews with the support services and students confirmed this. This cooperation starts from the moment of admission and goes along with each step of the study path.

The interviewed support services staff members recognised well their role in creating the framework where the students can achieve the learning outcomes set for the degree programme. The library provides training and guidance in information seeking for the students. Therefore, they have a joint role with the teaching staff members when ensuring the achievement of the learning outcomes in information retrieval. E-learning designers attend to the planning of the course implementations and support the teaching staff in the creation of the online courses. Project engineers function as a support for the teaching staff when they plan and carry out RDI projects with the industry partners. Administrative planners produce information e.g. on the progress of studies, which helps the management and teaching staff to follow-up and develop the degree programme.

In order to have a close collaboration with the students, depending on the field of action, support services have direct discussions with the students to hear their ideas of improvement or project, so that help from their side is manifested as soon as possible. Besides these

direct discussions, there are some formal ways of gathering feedback from the students, too.

Also, some of the support services are very well connected with the industry for finding places for students to practice the things that they learned or to gather some feedback from them, such that the improvement to be done in a connection with the future of the field.

Students' learning and well-being are supported by study counselling, career and student tutoring and mentoring, and student psychologist services. The development of students' well-being at JAMK is the responsibility of a multidisciplinary well-being team, which also has experts from outside JAMK as its members. There are guidelines that ensure that an accessible study environment and student health care services are available to the students. Student associations within the student union JAMKO provide sports and leisure-time activities for all JAMK students.

Career tutors play a central role in supporting students during the learning process. They are in charge of managing the personal learning plan (PLP) system as a part of the studies. The PLPs are drafted in the beginning of the studies jointly with the students and updated each study year. There are different types of activities that are implemented by these tutors, like discussions about study progress, discussions about thesis progress, or helping students with practical training matters, such as finding internships. International students as well as exchange students have their own contact person who guides them through the time they spent at JAMK.

Based on the team's assessment, the degree programme meets Standard 11 fully.

Standard 12: The classrooms, computing facilities, software, laboratories, workshops, libraries and associated equipment and services are sufficient and accessible to enable students to achieve the programme learning outcomes.

As a whole, JAMK and the degree programme offer a large variety of learning facilities for the students to ensure that the learning outcomes set for the programme are possible to achieve. Many of the general facilities are common for all JAMK´s students.

The School of Technology is located on JAMK´s main campus in Jyväskylä, along with the degree programme in Electrical and Automation Engineering. Contact lessons and group work are held in the main campus classrooms. For each session there is a reservation for a specific classroom. The number of students and equipment needed are considered. All students can view the weekly schedules for the classroom where lessons or group work will take place. JAMK offers individual and group workspaces for students. The rooms can be booked using an online reservation system. Some rooms are also free for use without booking. In its self-evaluation report, the degree programme has identified the need to further enhance the self-working spaces for the students on the campus.

There are several computer classes and other possibilities for students to use computers at the main campus. Students can also bring their own devices and use JAMK's Wi-Fi free of charge. JAMK provides the necessary software and their licences to students that are needed in their studies and in their future profession. Students and staff have their own JAMK email addresses that help communication and delivering information to everybody. Helpdesk supports students in technical matters such as usernames and printing. Facility services are responsible for the equipment and healthiness of the premises.

The library offers databases so that students have quick access to online material such as electronic books and journals at any place and at any time. The library also offers numerous printed books, journals, and other material that can be borrowed by the students. The library's materials are continuously updated and there is also an acquisition service for material that is not yet available in the library's collection. The electronic resources are available to the degree programme students even outside JAMK's network.

According to the self-evaluation report, the most important information systems for students are the virtual learning environment Moodle and Optima, the course registration and grade registration system Peppi and the students' intranet. Moodle is mainly used as a place for storing teaching material but it also has interactive tools for teaching and learning. The electronic desktop Elmo is one of the tools for teamwork and internal communication. According to JAMK's strategy, all courses in Electrical and Automation Engineering Programme are available through JAMK open university. Therefore, online facilities and eLearning will be the core of future education development.

The Industrial Engineering Department has several laboratories available: CAE (Computer Aided Engineering) laboratories, automation laboratories, electrical engineering laboratories, a process engineering laboratory and a mechanical engineering laboratory. Also, the laboratory of physics and some ICT environments are available. Students can install AutoCAD on their own computers, and they have a licence for using it as long as they are studying at JAMK.

There are several automation laboratories for robotics and machine vision, building automation, PLCs (Programmable Logic Controllers) and process automation. Siemen's PLC products are mostly used in laboratories. Laboratory facilities are a very important part of the degree programme, and hence, they are extensively used. Typical laboratory work contains, i.e., configurating, programming, installing, wiring and testing. Students can also operate in the automation laboratories individually in their own time. The DCS (Distributed Control System) of Metso is used for real process controls and it also supports remote use 24/7. PLC portals can also be used remotely. Through this structure, students are trained in self-organization and their self-learning competence, adaptable to their available time slots.

The process industry has a long history in Central Finland, which has influenced JAMK's learning environments. Two bigger separate processes for water and steam are available in laboratories. Currently, other areas of automation e.g., robotics and building automation also have an increasing role in laboratory development.

Electrical engineering laboratories are an essential part of electrical power engineering studies. In electrical engineering laboratories, students get acquainted with the basic measurements of electrical engineering, the most typical electrical machines e.g., motors, transformers, electricity distribution techniques and components, the design and testing of electrical network protections and the measurement of power quality. Due to safety considerations, students cannot operate in the electrical laboratories alone, but all measurements are made in a supervised manner.

JAMK has invested in laboratory facilities, and they seem to be the key facilities supporting the achievement of the learning outcomes of the degree programme, on the programme level and on the course level. In its self-evaluation report the degree programme sees maintaining good laboratory facilities as one of its development areas. The accreditation team agrees with this notion.

Laboratory access is usually restricted, although some facilities are freely open for students' own work. Lab facilities are equipped with many instruments used in Finnish business and technology. They help students to become familiar with the same laboratories and equipment that they will possibly use in their future work duties. The facilities together with teaching and learning activities support the achievement of the programme level learning outcomes well.

Based on the team's assessment, the degree programme meets Standard 12 fully.

Standard 13: The HEI and the programme have external partnership that are adequate to the achievement of the programme learning outcomes.

The Industrial Engineering Department at JAMK has a good and established partnership network with the regional industry, which makes it possible for the students to do real working-life projects and provides them with practical-training placements. During their studies, students of Electrical and Automation Engineering engage in cooperation with local/regional/national/international industry and business life on a regular basis.

Some of the most important local partner companies of the Electrical and Automation Engineering Programme are identified. The network represents different kind of companies, like consulting, manufacturing, electricity distribution and process industry well.

The correspondence between working life and the degree programme is ensured by means of the strategic Advisory Board of Electrical and Automation Engineering, which is carried out on a regular basis. The programme has an advisory board which consists of company representatives. The role of the advisory board is to ensure that the content of the programme is of high quality and suitable for the future professional field of electrical and automation engineering.

There is a good variety of different kinds of RDI projects in co-operation with network companies that run continually.

An important part of the partnerships is collaboration with higher education institutions both nationally and internationally. This network gives the students many studies, and practical training exchange possibilities and promotes exchanges of staff and lecturers; visiting lecturers come to teach in the degree programme and the programme´s own lecturers have possibilities to teach in partner universities abroad. International lecturers bring added value to teaching when the visiting lecturers' contribution is carefully and systematically integrated into the courses. Student, staff and lecturer exchanges are based on annual objectives which are defined based on JAMK strategy.

Partners are actively sought, for example, by taking part in international forums and making benchmark visits to selected universities. The Management Team of the School of Technology has agreed with the criteria of university partners. University partners are categorised according to the depth of cooperation and common objectives. At the most active level are the partners with whom the Industrial Engineering Department has regular lecturer and student exchanges and/or RDI projects. The teaching topics of the visiting lecturers in subject areas are integrated into the contents of the courses and visits are repeated annually. With these active partners, the Industrial Engineering department aims to deepen cooperation. It is very important that the partner universities can provide the degree programmes with an opportunity for the students to specialise in specific sectors of automation engineering.

The Mechanical Engineering double-degree programme with Esslingen University of Applied Sciences was agreed on in May 2012 and the Mechatronics-Electrical and Automation Engineering double-degree programme in November 2015.

The Electrical Engineering programme has cooperation with Finnish universities. One way to cooperate is sharing laboratories. This kind of partnership exists with Savonia University of Applied Sciences (located in Kuopio). As a local partnership, JAMK cooperates with the University of Jyväskylä and the Jyväskylä Education Consortium.

Present day applied research and cooperation is EU-wide, which must be considered in the framework of developing JAMK European collaboration. Especially the rapid development in industry and its future possibilities utilising the Industry 5.0 platform as a next-level manufacturing entity need special attention. Also, for that reason, JAMK is a member of the EFFRA, The European Factories of the Future Research Association. With this membership, JAMK can network rapidly within Europe with the most benefitting enterprises and research institutes thus making desired knowledge and services available.

Based on the team's assessment, the degree programme meets Standard 13 fully.

From 2021 onwards, a new financing model for universities of applied sciences (UAS) has been in use. The Ministry of Education and Culture allocates the funding to JAMK, which has its own internal budget allocation system. The lowest budgeting level is the department, and thus the single degree programmes do not have their own budgets. According to the self-evaluation material and interviews, there is a process in place for the internal budget allocation.

The self-evaluation report shows that the entire revenue budget for 2021 for the Industrial Engineering Department is €4.7M. The budget is divided into basic education €2.9M (Ministry of Education) and other income €1.8M (RDI projects' financing, service sales).

The basic education funding focuses mainly on the teaching and support staff and rentals. This includes costs for staff continuing education and training, including investments in the laboratory infrastructure. The degree programme recognizes adequately that the national funding policy creates incentives for the timely graduation of the students.

According to the interview with the management, this financial situation has been reflected on, especially the splitting of the Industrial Engineering Department budget into the different degree programmes. This splitting will be discussed and defined on a yearly basis, where the special needs of each study program will be considered. This means in reality, depending on the necessary investments and the running R&D projects, that the budget will be allocated in a way to guarantee the whole financing of each degree programme. Although the budgeting system in use does not allow to separately assess the resources of the degree programme under review, the evidence provided in the self-evaluation report along with its appendices, interviews and recorded facilities tour confirm that the degree programme has adequate financial resources to guarantee its planning and implementation.

The degree programme also has plans to increase the amount of external funding sources. For instance, new students out of the EU are addressed to study at JAMK to enable additional income for the degree programme. Based on this, also the lack of technical experts in the area of electrical and automation will be addressed and closed. This also gives the R&D partners of the degree programme the possibility to recruit new employees.

Because many parts of the actual degree programme are already available in English, a new group of possible students outside of the EU could be addressed. This gives on the mid-term good chances for new income and parallel to that the possibility to get future experts in Electrical and Automation Engineering for the industry of Central Finland.

In addition to this, a closer cooperation with the city of Jyväskylä is planned, so that this will also provide the possibility of getting additional financing for the Industrial Engineering Department.

All these activities underline that this factor has been considered by the management of the JAMK university of applies sciences and the management of the Industrial Engineering Department. Through the interviews all these issues have been addressed and the management of JAMK, the management of the Industrial Engineering Department and the study program management are explained clearly.

As a conclusion, the financing of the degree programme is guaranteed currently and a clear vision for additional future financing opportunities have been given.

Based on the team's assessment, the degree programme meets Standard 14 fully.

Strengths, good practice and areas for further development regarding section 2.3: resources

The team notes the following strengths and good practice in this section:

- The facilities at JAMK and around the degree programme, such as laboratories, the library, computer classes and software licences, are available for the students and seemingly reflect the degree programme learning outcomes. Especially the laboratories along with the full-time access support the achievement of the engineering practise learning outcomes in an excellent manner.
- There is a good variety of different kinds of RDI projects in co-operation with network companies that are continually running.
- The support services provided for the students at different stages of the study path effectively support the achievement of the learning outcomes set for the degree programme.

The team sees the following as areas for further development in this section:

- It is recommended to continue the efforts made in the digitalization of the teaching and learning environments, e.g. virtualization of the laboratories.

2.4. Quality management

Standard 15: The quality management procedures of the programme are consistent with the quality policy of the higher education institution.

Based on the self-evaluation report as well as interviews with the different parties around the degree programme, JAMK has a common quality policy and a quality system, which are implemented on the degree programme level. The quality system and procedures are very well described in JAMK's Quality Manual and the TOKA Process Manual.

JAMK's quality policy consists of the following principles:

- Promoting quality at JAMK University of Applied Sciences,

- Improving work and results continuously and renewing our ways of operating, and

- Strengthening a quality culture that involves the members of the academic community and external interest groups.

The Rector appoints JAMK's Quality Team. In schools, there are part-time quality officers whose responsibilities are to ensure that the quality system works and is developed in the school. Their task is to develop JAMK's quality system as members of the JAMK Quality Team and to support the heads of department and R&D managers in implementing quality management in education, RDI work, and service business. The quality officers report to the director of their school. The Head of the Technology Department is a member of the Schools Management Team and communicates the quality-related matters between management and The Industrial Engineering department.

JAMK's Quality Manager is responsible for the functioning of JAMK's quality system and the continuous development of the system. The Quality Manager's tasks include anticipating national and international trends in quality management and planning, coordination, follow-up, and development related to quality management. The Quality Manager presents issues in the JAMK Quality Team and reports to the Vice Rector.

In the School of Technology, there is the School Quality Team, which assists the School Management Team in quality matters. The School Quality Team submits proposals to the School Management Team. The team is appointed by the School Director. The School Quality Team comprises the quality officer of the School of Technology, the department quality coordinators, and a student representative. The student representative is appointed by the Student Union. Thus, the degree programme has a direct link to the School´s Quality team via their department representative.

The interviews confirmed that management, teaching staff members as well as support services staff are all committed to the improvement of the quality of their own work, jointly with the other colleagues, students and industry partners.

The training and communication of the Quality Manual was noticed to be an area to be improved. Many new staff members, teachers etc. have come to the organization recently and knowledge about manual was to some extent weak. Training should be addressed to the whole organisation. It should be ensured that all JAMK's staff and students have access to the Quality Manual and are informed of the changes in the handbook. It would be useful to further improve the internal visibility of the complete handbook and the quality work on the degree programme level (possibly along with a short video about the essential needs and contents); the Head of the degree programme, and also the involved teachers and administration, would be efficiently supported in their management and continuous curriculum development by a broader visibility of the clearly articulated common view of quality work and processes at JAMK.

The quality management procedures of the degree programme are consistent with the quality policy. Based on the discussions with all stakeholders, quality policy is implemented at the programme level, but it is good to consider more active and frequent communication and training, especially for new teachers, staff members and students as well.

Based on the team's assessment, the degree programme meets Standard 15 fully.

Standard 16: The organisation and decision-making processes of the programme are fit for effective management.

Based on the self-evaluation report and interviews, the degree programme has organisational as well as decision-making processes that are fit for effective management.

The Management Team of the School of Technology comprises the School Director, department/institute heads, an administrative planner and a personnel representative. The Management Team convenes monthly. The Management Team's memorandums are readily available for review in the document management system.

Each degree programme has a Head of Programme who is responsible for the structure and coordination of the realisation of the degree programme. In addition, the Product Development, Applied Research and Business Laboratories each have their own team. The personnel of the schools are organised into expert teams. Each team has a Team Leader who is responsible for developing the team and its resource planning. The teams are fully responsible for the planning of their area of responsibility, supported by the Team Leader and the head of department. The Team Leader is a supervisor who is responsible for setting up the team's targets in line with the targets of the school and department. The Team Leader conducts discussions with the team personnel, and they are responsible for allocating resources to the team's work. The team leaders work under the authority of the Head of Department.

The planning and decision-making process on the curriculum plays a central role when assuring the achievement of the programme learning outcomes. The degree programme has a designated team for the curriculum development. The team consists of programme staff members, and it is in charge of involving the students´ and industry partners´ feedback in the work. This includes e.g. the results of the Advisory Board's work as well as student feedback gathered through the various channels. The curriculum work follows the principles of the continuous development at JAMK.

According to the self-evaluation, JAMK Management creates the planning framework, approves the basic guidelines for curricula and approves the curricula for the degree programmes. Educational Development Services prepare curriculum guidelines and comment on draft curricula. The curricula are also assessed by the Education Development Services. Their evaluation is based on comments given by the Heads of programmes and the team working with the curriculum update. The curricula are checked annually for possible minor changes. A more profound update is made every five years. JAMK´s Students Affairs Board approves the curricula at the end of the process.

Based on the team's assessment, the degree programme meets Standard 16 fully.

> Standard 17: The programme reviews and develops the programme aims, curriculum, teaching and learning process, resources and partnerships and quality management in a systematic and regular manner, taking into account analysis of results of student admissions, students' study progress, achieved learning levels, student, graduate and employer feedback and graduate's employment data.

The degree programme is cyclically reviewed by integrating the feedback of the industry partners and students. JAMK reviews the degree programmes more thoroughly every six years. The Periodic evaluation of degree-awarding education is an evaluation method developed by JAMK to meet the European quality assurance standards and guidelines on the regular review of degree programmes. According to the self-evaluation report, Periodic evaluation is a tool for ensuring a minimum level of quality in planning, implementation and development of education.

The latest periodic evaluation of the Degree Programme in Electrical and Automation Engineering was carried out in 2015. After the evaluation, the following development measures were implemented:

- A survey of the MOOC courses and their suitability to the degree programme curriculum
- Improving the use of e-material in teaching
- Increasing the offerings of courses which are independent of time and place
- A survey of the tools for planning blended learning implementations in the future
- Clarification and harmonisation of learning assessment criteria in the courses.

The JAMK Quality System recognises two major ways of utilising the information produced by the quality system:

1) daily improvement and 2) making use of follow-up and evaluation. Daily improvement means that all the staff and students continuously strive to make daily improvements in their own work and study. Making use of follow-up and evaluation means that we have joint procedures for the processing of indicators, feedback information and evaluations. Most typically, the Quality Officer or the School Quality Team analyses the information and reports the most important observations to the Management Team, which makes conclusions and decisions about the development actions.

All persons working at JAMK continuously develop their own work and competence to improve the quality of the education, RDI activities and services. Immediate corrective measures are supported by the following operating methods, as described in the self-evaluation report:

- A teacher or an expert takes corrective measures related to direct feedback. Measures to be taken due to complaint-type feedback are agreed upon with the teacher's/expert's immediate superior.

- Teachers collect mid-course feedback in the Peppi course feedback system or in free form to gather information about students' experiences of the course.

- A teacher changes the course implementation based on course feedback and at their discretion. The teacher will discuss the feedback with the head of department when necessary.

The School Quality Team convenes 1–2 times during the academic year. The School Quality Team addresses any feedback received. It issues recommendations, makes development proposals, and serves as a liaison for the school's Management Team and other operators. The School Quality Officer, supported by the School Quality Team, prepares the annual quality review, in which the Management Team of the school makes a decision on the implementation of development proposals and ideas. The quality review enables the monitoring of the development actions. The implementation of the development measures pertaining to degree programmes is monitored by the Head of Department or the programme coordinator, supported by the School Quality Officer.

Student admission statistics are created in conjunction with student enrolment, and the statistics are available on the nationwide education administration's reporting portal Vipunen. The student's study progress and achieved learning levels are followed via the student management system.

A new Peppi system for the course feedback was introduced in spring 2021. The teacher may make changes to the course on the basis of the course feedback. Overall student feedback is collected every year during the feedback week, which is organised by the student union JAMKO. Students can interact directly with teaching staff when the feedback is discussed.

The current feedback rate is quite low (app. 30%). In the interviews with the teaching staff there were varying opinions on the reasons, as well as preferred ways to improve the situation. Some the teachers would prefer decreasing the amount of feedback collected, as students are expected to submit separate feedback forms on each course. In the interviews students noted that transparency to feedback results and corrective actions were sometimes poor, and thus that this is an area to be improved in the feedback utilization process. This weak visibility also demotivates students to give feedback, as they do not see any response or activity based on it. As a conclusion, the students themselves did not see the amount of feedback being too high, but for some of the teaching staff members the current amount seems challenging. It is recommended to raise discussion on this matter in the degree programme and jointly develop ways to better integrate the feedback practises into the teaching and learning processes. The feedback system Peppi itself was commented to be good.

At the end of their studies, students respond to the AVOP feedback administered by the Ministry of Education and Culture. The results are analysed, and the improvement measures are decided at the school and university level. In the national comparison, the programme has succeeded very well in AVOP feedback among similar degree programmes. The programme has been ranked as 1st or 2nd place in the last five years.

In conjunction with the AVOP feedback, students are asked about their employment prospects. Official employment statistics and the career monitoring survey data concerning bachelor's and master's degree programmes are available via the Vipunen portal. Employment data is one indicator among the JAMK scorecard indicators. The JAMK Management Team proceeds the scorecard follow-up, currently based on online reports (Power BI).

Employer feedback is collected in the client interviews and in alumni feedback collected by the Ministry of Education and Culture. Currently, the client interviews have had to be postponed because of the Covid-19 pandemic.

Based on the discussions and management system and organisation descriptions, the organisation and decision-making processes for effective management of the programme seem to exist and effective decision-making processes for the quality management of programme are functioning.

Based on the team's assessment, the degree programme meets Standard 17 fully.

> ## Standard 18: The programme provides public, up to date information about its objectives, teaching and learning process, resources, quality management procedures and results.

Based on the self-evaluation report along with its appendices, the intranet as well as information on the JAMK website, the programme provides public information on all its key features. Information is available for all the relevant stakeholders. This was confirmed in the interviews with the management, staff members, students, alumni and external

stakeholders. Furthermore, the information aimed at the students is available both on the website and intranet and covers all the stages of the study path. The information is very well structured and easily accessed without much trouble.

Quality news is disseminated to the staff and students via the staff's intranet and the students' Quality Channel. The Quality Channel provides information about student feedback, placement follow-up and the graduates' work duties, among other things. The departments' quality officers inform new students about their opportunities to exert influence during a course entitled Development as an Expert.

Based on the team's assessment, the degree programme meets Standard 18 fully.

Strengths, good practice and areas for further development regarding section 2.4: quality management

The team notes the following strengths and good practice in this section:

- Quality management organisation and procedures are very well described in JAMK's Quality Manual and the TOKA Process Manual.
- The quality management procedures of the degree programme are consistent with the quality policy.

The team sees the following as areas for further development in this section:

- Quality policy is implemented on the degree programme level, but it is recommended to consider more active and frequent communication and training, especially for new teachers, other staff members and students as well.
- There is a good student feedback system in place, but its use requires further actions. The feedback system should be more transparent. It is advisable to have a continuous discussion on the feedback results within each course between the teachers and students.
- The alumni community should be structurally involved in the continuous degree programme development.

Overall evaluation of the degree programme

3

Upon reviewing the degree programme, the team highlights the following **key strengths and good practice**:

- Student-centredness is at a good level and well taken care of in terms of achievement of learning outcomes.
- Close cooperation between the degree programme and the related industry via the Advisory Board, RDI projects, the InnoFlash course and practical training.
- Curriculum strongly focuses on the professional field.
- Future engineering skills have been reflected and listed with the key external stakeholders.
- Entrepreneurship and innovation have been identified as future matters.

The team sees the following as **main areas for further development** of the degree programme:

- Generic competences (e.g. social skills, communication, team-working) could be communicated more clearly on the learning activity level to highlight the importance of them for the students.
- The student feedback process should be more transparent and there should be continuous discussion on the feedback results within each course between the teachers and students.
- It is recommended to further develop some of the course-level learning outcomes and to support the teaching staff to deploy them to students.
- The alumni community should be structurally involved in the continuous degree programme development.
- Awareness of the core processes and process manual among the staff members should be enhanced. It is recommended to consider more active and frequent communication and training, especially for new teachers, other staff members and students as well.

The accreditation team recommends that the degree programme is *accredited without reservation*.

FINEEC Committee for Engineering Education's Decision

4

In its meeting on 4 March 2022, the FINEEC Committee for Engineering Education decided, based on the proposal and report of the accreditation team, that the Degree programme in Electrical and Automation Engineering at JAMK University of Applied Sciences is accredited without reservation. The accreditation is valid until 4 March 2028.

Engineering programme accreditation is a degree programme specific evaluation that can lead to the European EUR-ACE® Label. The accreditation aims to support the enhancement of quality in engineering degree programmes and increase the international comparability and recognition of engineering degrees within Europe. The accreditation is voluntary for Finnish higher education institutions and degree programmes. This report presents the process and results of the accreditation of the Degree Programme in Electrical and Automation Engineering at JAMK University of Applied Sciences in Finland.

The Finnish Education Evaluation Centre (FINEEC) is an independent, state evaluation agency responsible for the external evaluations of education from early childhood education to higher education in Finland. It implements system and thematic evaluations, learning outcome evaluations and field-specific evaluations. Moreover, FINEEC supports providers of education and training and higher education institutions in matters related to evaluation and quality assurance, as well as advances the evaluation of education.

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