ASIIN Seal & EUR-ACE® Label

Accreditation Report

Bachelor's Degree Programmes
Electrical Engineering
Mechanical Engineering

Master's Degree Programmes
Electrical Engineering
Mechatronic System Design
Welded Metal Structures
Sustainable Production in Mechanical Engineering

Provided by
Lappeenranta University of Technology (LUT), Finland

Version: 20 September 2019

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A About the Accreditation Process

Name of the degree programme (in original language)	(Official) English translation of the name	Labels applied for [1]	Previous accreditation (issuing agency, validity)	Involved Technical Committees (TC)[2]
Tekniikan kandidaatin tutkinto-ohjelma, sähkötekniikka	Bachelor's programme in Electrical Engineering	ASIIN, EUR-ACE® Label	ASIIN, 2011 – 2016 (prolonged until 2017)	02
Diplomi-insinööri, sähkötekniikka (Sähkötekniikan diplomi-insinöörin tutkinto-ohjelma)	Master's programme in Electrical Engineering	ASIIN, EUR-ACE® Label	ASIIN, 2011 – 2016 (prolonged until 2017)	02
Tekniikan kandidaatin tutkinto-ohjelma, konetekniikka	Bachelor's programme in Mechanical Engineering	ASIIN, EUR-ACE® Label	ASIIN, 2012 – 2017	01
Master's programme in Mechatronic System Design	Master's Programme in Mechatronic System Design (former Master's programme in Mechanical Engineering)	ASIIN, EUR-ACE® Label	ASIIN, 2012 – 2017 (former Master's programme in Mechanical Engineering)	**01**, 02
Master's programme in Welded Metal Structures	Master's Programme in Welded Metal Structures (former Master's programme in Mechanical	ASIIN, EUR-ACE® Label	ASIIN, 2012 – 2017 (former Master's programme	01

[1] ASIIN Seal for degree programmes; EUR-ACE® Label: European Label for Engineering Programmes

[2] TC: Technical Committee for the following subject areas: TC 01 – Mechanical Engineering/Process Engineering; TC 02 – Electrical Engineering/Information Technology

	Engineering)		in Mechanical Engineering)	
Master's programme in Sustainable Production in Mechanical Engineering	Master's Programme in Sustainable Production in Mechanical Engineering (former Master's Degree Programme in Mechanical Engineering)	ASIIN, EUR-ACE® Label	ASIIN, 2012 – 2017 (former Master's programme in Mechanical Engineering)	01

Date of the contract: 18.08.2016

Submission of the final version of the self-assessment report: 23.02.2017

Date of the onsite visit: 05./06.04.2017

at: Lappeenranta

Peer panel:

Prof. Dr.-Ing. habil. Andreas Braunschweig, University of Applied Sciences Schmalkalden;

Prof. Dr. Madhukar Chandra, Technical University of Chemnitz;

Dr. rer.nat. Christoph Hanisch, Festo AG & Co. KG;

Lumi Ketola, Student at Aalto University;

Prof. Dr. Alfons Klönne, University of Applied Sciences Karlsruhe;

Prof. Dr.-Ing. Jörg Wauer, Karlsruhe Institute of Technology

Representative of the ASIIN headquarter: Dr. Siegfried Hermes

Responsible decision-making committee: Accreditation Commission for Degree Programmes

Criteria used:

European Standards and Guidelines as of 15.05.2015

ASIIN General Criteria, as of 28.03.2014

Subject-Specific Criteria of Technical Committee 01 – Mechanical Engineering/Process Engineering and 02 – Electrical Engineering and Information Technology as of 09.12.2011

B Characteristics of the Degree Programmes

a) Name	Final degree (original/English translation)	b) Areas of Specialization	c) Corresponding level of the EQF[3]	d) Mode of Study	e) Double/Joint Degree	f) Duration	g) Credit points/unit	h) Intake rhythm & First time of offer
Electrical Engineering	B.Sc. in Technology	./.	6	Full time	./.	6 Semester	180 ECTS	Autumn semester
Mechanical Engineering	B.Sc. in Technology	./.	6	Full time	./.	6 Semester	180 ECTS	Autumn semester
Electrical Engineering	M.Sc. in Technology	./.	7	Full time	./.	4 Semester	120 ECTS	Autumn semester
Mechatronic System Design	M.Sc. in Technology	./.	7	Full time	./.	4 Semester	120 ECTS	Autumn semester
Welded Metal Structures	M.Sc. in Technology	./.	7	Full time	./.	4 Semester	120 ECTS	Autumn semester
Sustainable Production in Mechanical Engineering	M.Sc. in Technology	./.	7	Full time	./.	4 Semester	120 ECTS	Autumn semester

For the Bachelor's degree programme Electrical Engineering the institution has presented the following profile in the self-assessment report:

"In the Bachelor's Programme in Electrical Engineering, students learn about different energy production methods, electricity distribution and transfer. Additionally, they learn the

[3] EQF = The European Qualifications Framework for lifelong learning

basics of electrical machines. The students also have a possibility to choose electrical BSc and MSc programmes in Electrical Engineering and Mechanical Engineering markets in their studies. Additionally, the basics of entrepreneurship and sustainability are compulsory for all the electrical engineering students."

For the Master's degree programme Electrical Engineering the institution has presented the following profile in self-assessment report:

"In the Master's Programme in Electrical Engineering, students have the possibility to study electrical power lines, electricity markets, power electronics, electrical machines, solar economy, and renewable technologies, which all are at the core of the LUT strategy."

For the Bachelor's degree programme Mechanical Engineering the institution has presented the following profile in the self-assessment report:

"The Bachelor's Programme in Mechanical Engineering includes the compulsory course 'The Basics of Business Economics', and students are also recommended to choose minor studies either in Energy Technology or Entrepreneurship, which connect the education in Mechanical Engineering to the strategy of LUT. Additionally, sustainable aspects are taught in many courses in BSc and MSc programmes in Mechanical Engineering."

For the Master's degree programme Mechatronic System Design the institution has presented the following profile in self-assessment report:

"Research and education in the Master's Programme in Mechatronic System Design enables more effective approaches to all of LUT's strategic focus areas. The foundation of this MSc programme is the SIM (Sustainable product processes through simulation) research platform, which focuses on energy-efficient machine design using real-time simulation and is one of LUT's strategic spearheads."

For the Master's degree programme Welded Metal Structures the institution has presented the following profile in self-assessment report:

"The Master's Programme in Welded Metal Structures offers the latest knowledge and expertise in the design and manufacture of innovative, sustainable, competitive and safe

welded metal structures for demanding applications, especially those including dynamic loads or arctic conditions."

For the Master's degree programme Sustainable Production in Mechanical Engineering the institution has presented the following profile in self-assessment report:

"The Master's Programme in Sustainable Production in Mechanical Engineering offers knowledge and skills to increase competitiveness in manufacturing. Selecting and then properly applying the most appropriate manufacturing methods assures the development of the best possible supply chain and maximises business profitability."

C Peer Report for the ASIIN Seal[4]

1. The Degree Programme: Concept, content & implementation

Criterion 1.1 Objectives and learning outcomes of a degree programme (intended qualifications profile)

Evidence:

- Learning outcomes according to the SAR, see Appendix; available on the internet: https://uni.lut.fi/fi/kandidaatin-opinnot10 (Ba Electrical Engineering, in Finnish language only); https://uni.lut.fi/fi/web/guest/di-opinnot6 (Ma Electrical Engineering, in Finnish language only); https://uni.lut.fi/en/web/lut.fi-eng/master-s-degree-studies5 (Ma Electrical Engineering, English website); https://uni.lut.fi/fi/web/guest/kandidaatin-opinnot12 (Ba Mechanical Engineering, in Finnish language only); https://uni.lut.fi/en/web/lut.fi-eng/master-s-degree-studies1 (Ma Mechatronic Systems Design, Ma Welded Metal Structures, Ma Sustainable Production in Mechanical Engineering)
- Curriculum Tool for each degree programme, encompassing an objectives-module-matrix, by and large providing evidence of equivalency of learning outcomes of the programmes and the respective Subject-Specific Criteria of the responsible Technical Committees 02 – Electrical Engineering/Information Technology and/or 01 – Mechanical Engineering/Process Engineering; Appendices 4 to 9 to the SAR
- Description of learning objectives / qualification profile in the respective Diploma Supplement
- Study Guides of the degree programmes; Appendices 11 to 16 to the SAR
- Performance of programmes indicators 2014-2016; Appendix 18 to the SAR
- Alumni career survey; Appendix 20b
- Audit discussions

[4] This part of the report applies also for the assessment for the European subject-specific labels. After the conclusion of the procedure, the stated requirements and/or recommendations and the deadlines are equally valid for the ASIIN seal as well as for the sought subject-specific label.

Preliminary assessment and analysis of the peers:
Study objectives and learning outcomes, in particular, have been identified and formulated for each of the programmes under review. It seems that these are easily available for students, applicants and other stakeholders on the web pages of the university. At least partly they are also accessible in English which is certainly true for the newly structured Master's degree programmes in Mechanical Engineering altogether taught in English.

Regarding the Master's programme in Electrical Engineering, it is conceived to be generally laudable that in view of its internationalization strategy LUT School of Energy Systems is about to offer an ever more internationalized, two-language (Finnish-English) degree programme starting from the academic year 2017-2018. Most of the core and specialisation modules and courses respectively will then be taught in English, very few in Finnish only. Generally, this is already reflected not only in the course descriptions[5], but also in the English version of the programme learning outcomes on the internet. On the English website the Master's programme is presented as a two-pillar specialisation degree programme. With a wide array of modules at hand (each module representing a combination of elective, thematically related courses), students are supposed to settle their individual study plans within two broader fields of specialisation. On the one hand they might opt for "Industrial Electronics", which includes studies in electrical drives technology and control engineering, focusing on electromagnetism, power electronics, electromechanical and electrothermal processes, industrial applications of real-time control systems, embedded systems, digital signal processing, and on the application of these to the modelling and control of electrical drives and power electronics, or choose "Solar Economy" on the other which focuses on studies in renewable energy sources and technologies, in energy sustainable strategy and business, in smart grids and electricity markets, trading, models and business. It appears that the learning outcomes presented on the English website of the Master's programme in Electrical Engineering are more concrete than those given in the SAR, but at the same time seem to be confined to the "Solar Economy"-track. Otherwise, when considering that the range of individual study tracks largely depends on the student's individual study plan and choice of modules and elective courses, his/her qualification profile may vary significantly. Consequently, the formulation of only a few generic discipline-specific skills and competences in advance does make sense. The "objectives-module-matrix" in the Curriculum Tool of the Master's degree programme Electrical Engineering illustrates several more distinguished learning outcomes for a specific module combination (Electricity Market, Electric Grids, Power Electronics). Regarding that, the heads of the degree programme may consider whether it is possible to exemplary differentiate qualification profiles with respect

[5] For the unfamiliar usage of the terms "module" and "course" in the light of the Bologna terminology, see sec. 2.1.

to main fields of specialisations or module combinations and make them publicly accessible.

With respect to the Bachelor's degree programmes Electrical Engineering and Mechanical Engineering, it is taken into account that these programmes are taught solely in Finnish. Peers therefore assume that the Internet links given in the SAR do refer to the respective Bachelor's degree programme, thus providing *inter alia* information about the programme-specific learning outcomes as stated in the SAR. Since the university follows an outspoken internationalization strategy, in which two-language or even three-language (Finnish, Swedish and English) degree programmes play an increasing important role, it is suggested presenting all study-related information about the Bachelor's programmes on the internet also in English. This appears not to be a heavy burden as it is already done for the Master's programmes under review.

It has been positively noted that there is a well-established process of gathering the feedback of both alumni/graduates and industry partners about the significance of the learning outcomes of the degree programmes and the qualification profile of graduates circumscribed therewith. Reportedly, learning outcomes are reviewed annually in a curriculum development process, thereby taking into account the demands and needs of main stakeholders like students and important industry partners. This has been confirmed by the commissioners of some of the industry companies the School of Energy Systems is cooperating with. Intercourse between programme coordinators and professors of LUT and those industry partners seems to be close and continuous. Thus for instance, companies engaged in the field of plant engineering and construction praise the students' knowledge and skills in material science, in particular with respect to welding structures. Results from alumni surveys and other feedback from external stakeholders largely corroborate the functionality of the quality assurance processes described in the SAR (see for further assessment sec. 6 of this report). In conjunction with this, it is appreciable that the degree programmes under consideration clearly reflect and are further developed in accordance with the mission and strategy of LUT, "which focuses on the research and education on clean energy, the circular economy, and sustainable business and entrepreneurship" (SAR, p. 10).

Up to here the assessment has been focusing on the availability and adaptability of the defined programme learning outcomes in relation to competence fields and strategic choices of LUT, student and alumni feedback as well as the demands of industry. The following chapter is going to deal with the question whether the programme-related learning outcomes (as to that see also the respective Appendix to this report) could be considered equivalent to those of the respective Subject-Specific Criteria (SSC) of the relevant Technical Committee.

By and large, this question can be answered in the affirmative, regardless of the fact that there is no one-to-one match between the learning outcomes on either side. Regarding the Bachelor's and Master's degree programmes, it can be stated that the core engineering competence fields "Knowledge and Understanding", "Engineering analysis", "Engineering design", "Engineering practice and product development" as well as "Transferable skills" are all covered by the programme learning outcomes defined by LUT to a certain extent. "To a certain extent" in this regard means that from the peers' perspective the difference of the qualification profile between the Bachelor's and the Master's level (EQF level 6 and 7) has been adequately addressed. Furthermore, the Curriculum Tool for each degree programme among other things clarifies how the learning outcomes of the various competence fields are achieved in the respective curriculum. As this Curriculum Tool turns out to be a decisive element for the development and evaluation of a degree programme and also implies essential information about it – worth to be known by students and teaching staff alike –, its availability for the most important stakeholders on the LUT intranet is highly esteemed (see also section 1.3).

Criterion 1.2 Name of the degree programme

Evidence:

- Study Guide of each degree programme; Appendices 11 – 16 to the SAR
- Websites of the degree programmes; accessible at: https://uni.lut.fi/fi/kandidaatin-opinnot10 (Ba Electrical Engineering, in Finnish language only); https://uni.lut.fi/fi/web/guest/di-opinnot6 (Ma Electrical Engineering, in Finnish language only); https://uni.lut.fi/en/web/lut.fi-eng/master-s-degree-studies5 (Ma Electrical Engineering, English website); https://uni.lut.fi/fi/web/guest/kandidaatin-opinnot12 (Ba Mechanical Engineering, in Finnish language only); https://uni.lut.fi/en/web/lut.fi-eng/master-s-degree-studies1 (Ma Mechatronic Systems Design, Ma Welded Metal Structures, Ma Sustainable Production in Mechanical Engineering)
- SAR and audit discussions

Preliminary assessment and analysis of the peers:

The name of the each degree programme is considered adequate. That applies to the Electrical Engineering as well as to the Mechanical Engineering programmes.

However, it should be noted that, considering the Master's programmes in Mechanical Engineering, peers acknowledged that the programmes have been evolved from the former stand-alone Master's programme in Mechanical Engineering in order to better reflect the

School of Energy Systems' strategic fields of research and relevant market needs. Peers suspect that maintaining a uniform Master Mechanical Engineering with different specialisation tracks might have been a more reasonable solution for this strategic aim. Otherwise, it seems plausible that dividing up the programme and developing more specified programmes in the field of Mechanical Engineering are supposed to be more attractive to potential applicants.

Irrespective of this assumption, it can be concluded that the compulsory curriculum of each of the Mechanical Engineering Master's programmes differs only in a narrow number of courses specifically attached to the respective programme name. It is difficult to decide whether this difference sufficiently rationalizes a separation of the programmes or rather would argue in favour of a unified programme with different specialisation tracks – as the peers would have it. In sum, peers acknowledge the argument of the LUT School of Energy Systems. However, splitting up the former Mechanical Engineering Master's programme implies that the underlying accreditation requirements for degree programmes are valid for each of the three newly structured Master's programmes as well. And – to name but this – during the onsite inspection of the laboratories, peers have received the impression that continued efforts will be indispensible to set up laboratory equipment which satisfies the needs of the specialized Master's programmes Mechatronic Systems Design, Welded Metal Structures and Sustainable Production in Mechanical Engineering (see for a more detailed discussion sec. 4.3).

Criterion 1.3 Curriculum

Evidence:

- Curriculum Tool for each degree programme; Appendices 4 – 9 to the SAR (study plan including learning objectives-course matrix, credit point distribution per course/semester, teaching and assessment methods)
- Study Guide for each degree programme; Appendices 11 – 16 to the SAR (module descriptions); available on the internet at: https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=101&Org=16194548&KohtTyypHierAuk=1 (Ba Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=95&Org=16194548&KohtTyypHierAuk=1 (Ba Mechanical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=127&Org=16194548&KohtTyypHierAuk=1 (Ma Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=128&Org=16194548 (Ma Mechatronic System Design); https://weboodi.lut.fi/oodi/vl_ke-

hys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=129&Org=16194548&KohtTyypHier-Auk=1 (Ma Welded Metal Structures); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=130&Org=16194548&KohtTyypHier-Auk=1 (Ma Sustainable Production in Mechanical Engineering)

- Respective chapter of the SAR (structure of the curricula; revision of the curricula since first accreditation of the degree programmes)
- Audit discussions

Preliminary assessment and analysis of the peers:
Generally, the concept of each of the degree programmes under review is considered consistent and suitable with regard to the programme learning outcomes and adequate in terms of content of the related courses. Peers are very fond of the apparent effort of the School of Energy Systems to align the programmes' design to the strategic aims and research areas of LUT. In principal, this judgment does also apply to the School's decision to split up the former Mechanical Engineering Master's programme, although a stand-alone Master's programme in Mechanical Engineering comprising three distinct specialisation tracks might have contributed even better to this aim (as to that see also the analysis in the previous chapter).

The peers conclude that, all in all, the degree programmes are designed to reflect the defined programme learning outcomes at the Bachelor's and Master's level, respectively. Thus, the Curriculum Tool for each of the Electrical Engineering and Mechanical Engineering programmes provides a reasonable overview of how the intended learning outcomes are expected to be achieved in the curriculum. It is indicated, for example, that an array of courses shall impart students with "basic skills of the technology in mathematics and science and [the ability] to solve problems by applying suitable mathematical methods" in the Bachelor Electrical Engineering. Similarly, a group of modules in the Mechanical Engineering Bachelor's programme is supposed to convey to students the ability of how to "utilize mathematics and physics to solve problems of mechanical engineering and design". As has been indicated in section 1.1, these capabilities can be considered equivalent to the relevant SSC's exemplary learning outcomes in the Natural Science and Mathematics as well as the Basics of Engineering-Knowledge area. In a similar vein, design competences requested and exemplary formulated by either SSC 01 Mechanical Engineering/Process Engineering or SSC 02 – Electrical Engineering/Information Technology, are indicated exemplary for an individual specialisation in the field of power electronics in the Master's programme Electrical Engineering ("Be able to design electricity distribution networks, with the focus on their electrotechnical design, protection design and techno-economic dimensioning") and

implemented accordingly through a series of elective specialisation courses. Comparable design competences which are defined for the Mechanical Engineering Master's programmes (for instance, "have ability to design and implement control systems for mechatronic machines" in case of the Master Mechatronic System Design) shall be acquired in certain core modules of the programme, and so on. The relevant engineering-specific as well as the non-technical, transferable competence fields are appropriately addressed in the learning outcomes and the respective Curriculum Tool clarifies which courses are considered appropriate to impart students with the intended knowledge, skills and competences. Peers are also thankful for differentiating these categories of learning outcomes when it comes to illustrating the successive completion of the competence profile of an engineer. In this context, it is of particular significance that competences contributing not only to personality and employability in a broader sense, but rather to the formation of the professional ethics of an engineer are dealt with in one way or the other for all degree programmes under consideration.

Taken together, the course descriptions can be considered as proof of the endeavour to transform the programme learning outcomes at the course level in an appropriate manner. However, regarding the alignment and interrelation of the intended course learning outcomes on the one hand and the description of the related course content on the other, it is observed that in some cases, predominantly in the Bachelor's degree programmes, the content overview needs to be more precise. It should align with confined learning outcomes more strictly in order to serve more adequately as the basis for measurable learning outcomes. This deficiency turns out to be potentially deleterious for the degree programmes as has been evidenced by some of the Bachelor's exams provided for inspection. In these cases the contents or course learning outcomes (or both) did not reflect the examination tasks properly, and, as a consequence, the exam results did not or only hardly fulfil the self-formulated high-level expectations at Bachelor's level. From the perspective of the peers, it is therefore of ultimate importance not only to check the consistency of course learning outcomes and course content on a regular basis, but also to monitor and include the assessment results when doing this in order to generally keep up the Bachelor's level of the programme as a whole. A process which is appropriate to sustainably achieve this objective should be developed and integrated in the quality assurance system of the degree programmes (especially at the Bachelor's level). Indirectly the issue also plays into the quality level the Bachelor theses, an issue that will be discussed in a subsequent chapter of this report (see sec. 3).

It generally adds to the plausibility of the specific curriculum design of the programmes that they are, reportedly, based on research activities and laboratories directly related to the disciplinary field or specialisation of the programme. Programme coordinators stressed

this point especially with regard to the Mechanical Engineering Master's programmes pointing to the laboratories of Sustainable Production in Mechanical Engineering, Mechatronic System Design and Welded Metal Structures respectively. But here again the peers rather received a somewhat sobering impression of the laboratory equipment, in particular for the Master's programmes in Mechanical Engineering when assessed with a view on their distinct focus area (see sec. 4.3).

Criterion 1.4 Admission requirements

Evidence:

- Respective Chapter of the SAR
- Information on the National Admission Website, accessible at: https://study-info.fi/wp2/en/ (English site)
- Sec. 36, 37 of Finnish „Universities Act 558/2009"; available on the internet: http://www.finlex.fi/en/laki/kaannokset/2009/en20090558.pdf
- Performance of Programmes Indicators; Appendix 18 to the SAR
- Alumni Career Survey - Master's graduates 2009; Appendix 20b to the SAR
- University Policy Paper "Trailblazer - Strategy 2020 - Lappeenranta University of Technology"; Appendix 1 to the SAR
- Audit discussions

Preliminary assessment and analysis of the peers:

The admission rules for the Bachelor's and the Master's degree programmes have been clearly set and bindingly fixed. They are transparent and easily available for applicants of both academic career paths. Thus, information about the requirements and the application and admission procedure is available on the LUT websites as well as on the National Admission website (in Finnish and English).

Concerning the Bachelor's programmes, applicants have usually completed the Finnish matriculation examination. Those who are not upper secondary school graduates but have completed a polytechnic higher vocational degree, vocational polytechnic degree or at least a three-year vocational degree may also apply. It is also possible to apply with certain foreign or international examinations, such as the European or International Baccalaureate or the Reifeprüfung degree (from die Deutsche Schule Helsinki). Students can be selected based on their Finnish matriculation examination results alone, their matriculation examination and entrance examination results combined, or only the entrance examination results. The entrance examination is based on the Finnish upper secondary school curriculum

in mathematics, physics and chemistry. Prospective students must pass the entrance examination to be selected even if there are fewer applicants than study places. As the peers acknowledge, this guarantees a minimum knowledge level in science for all selected students and thus contributes to the quality assurance of the Bachelor's programmes. To be selected based on the matriculation examination the prospective student must have at least the grade C in physics or chemistry and passed advanced studies in mathematics, or at least the grade M in advanced mathematics (with grades I, A, B, C, M, E, L from lowest to highest).

Regarding the Master's degree programmes, it is explicitly noted that according to the Finnish Universities Act, a student is admitted to study for both a lower and higher university degree, or to either of these. As the SAR concedes, this provision, in practice, leads to the admittance of all LUT students accepted in a specific Bachelor's programme to the related Master's programme as well, if the application is aimed at both. Only in case of an application for a Master's programme alone, the rule seems to be valid that applicants must have completed a relevant Bachelor's degree beforehand (sec. 37, 3 (1)). Thereby, the Bachelor's degree should be earned in the respective or a closely related field of study.

However, as the SAR underscores, the admission regulations for the Master's programmes do not prevent LUT students, who have applied for both a Bachelor's and a Master's degree, from commencing the Master's study before completing the Bachelor's degree. On the university's side it has been pointed out that although it is interested in maintaining the flexible transition from the Bachelor's studies to the Master's studies, "LUT has invested in strengthening the two-cycle structure of Bachelor's and Master's programmes in recent years" (SAR, p. 24). Thus, for instance, students are encouraged to complete their Bachelor's degree before starting their Master's studies. Furthermore, according to the SAR, the Master's thesis topic cannot be approved before completing the Bachelor's degree. And it is also stressed that the "national student financial aid system is connected to the progress of studies and thus supports the two-cycle structure".

These measures certainly have been taken against the background of a recommendation of the previous accreditation procedure advocating for a more clear-cut handling of the admission and completion issue in the two-cycle degree structure of the European Higher Education Area (EHEA).[6]

[6] Cf. the Accreditation Report for the Electrical Engineering programmes as of June 28, 2011, p. 23f.: "It is recommended that exceeding the standard period of study of the Bachelor´s programme should be the exception, not the rule. The university should device a practice that Bachelor students are only preliminarily admitted to the Master's degree programme before having completely finished the Bachelor's degree programme. They should be obliged to fulfill the admission requirements within a certain time span. *LUT should*

Back in 2011 the peers obviously have been preoccupied with safeguarding the quality level of Master's programmes. Now, considering the documented experience of an additional five years accreditation period, the peers rather doubt whether the presumptive regulation on the admission to the Bachelor's and Master's degree programmes do in fact impair the quality of the Bachelor's degree programmes in general and the Bachelor's theses in particular. As has been indicated above, the inspection of a sample of Bachelor's exams and theses during the onsite-visit at LUT gave plenty of hints that the Bachelor's level appears to be disputable in a considerable number of cases (see for further details sec. 3). Whether this is solely or predominantly attributable to the admission rules might be worthy of discussion. After all, the audit talks with students reveal that many of them apparently completed their Bachelor's studies before starting a consecutive Master's programme, which might be taken as proof of the functionality of the university policy mentioned before.

However, peers also observe that the Master's degree is obviously seen as the relevant degree for all intents and purposes by the School, teaching staff and students alike. Thus, results of an Alumni survey are presented for 2009 Master's graduates but not for Bachelor's graduates of any period and to all appearances this will be unchanged with the next survey of 2016. Furthermore, performance numbers for the Master's programmes – significantly contrasting to the Bachelor's programmes – encompass "output indicators" such as employment rate, average salary, and correspondence between education and competence requirements at work. These are crucial data with regard to the success of graduates in their studies and in the job market. In this regard, more meaningful data of the Bachelor's students and graduates may be missing because of a statistical data base which is generally felt to be deficient. Otherwise, the available data might also indicate the still minor significance of the Bachelor's degree programmes as compared to the Master's programmes. "Trailblazer - Strategy 2020 - Lappeenranta University of Technology", a University policy paper doesn't even mention the Bachelor programmes - a fact that might be telling in this regard too.

Regardless of this deliberation, the peers consider the admission regulations as such to be adequate. From their perspective the admission procedure is clearly aiming at applicants equipped with the knowledge and skills necessary to successfully pursue their chosen Bachelor's or Master's studies. With respect to the Master's programmes particularly, there are also rules in place for applicants who largely but not fully have acquired the knowledge and skills needed for the study programme (sec. 37 No. 4 Universities Act).

think of ways to guarantee the quality of Master level students to ensure that they compare with the European level."

Concerning the de facto admission of students to the Master's programmes who are already admitted to the Bachelor's programmes, the peers acknowledge the steps the university has taken in order to ensure that students normally would have completed their Bachelor's degree before commencing a Master's study. Therefore, the partly unsatisfying quality of Bachelor's examinations and Thesis works should not be directly attributed to this still questionable regulation. The attitude of students – as far as can be judged from the audit discussions – shows that many of them follow the university's recommendation regarding the completion of their Bachelor's degree in the standard period of time and, even more important, before beginning their Master's study. However, the more or less outspoken treatment of the Bachelor's degree as a mere pathway to the master's degree is suspected to contribute to programme-related decisions which, to a certain extent, negatively affect the quality of the Bachelor's programmes (see sec. 3 and 4.3 for further discussion of this issue).

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 1:

The peers consider the specifications of the above mentioned criterion (programme-specific learning objectives, name of the degree programmes, curriculum, and admission requirements) *mostly fulfilled*.

Bologna structure, Bachelor's programmes

They understand that the university is still on its way to fully implement the Bologna two-tier structure of study degree programmes, still partly impaired by national legislation. Actions taken to invigorate this structure and, in particular, the Bachelor's degree as a self-sustained scientific degree are considered helpful in promoting this process. Nevertheless, further steps need to be taken to fortify and even upgrade the quality of the Bachelor's degree, especially with regard to the examinations and final theses (see for more detail sec. 3; see also below, chap. E, A 5 and A 7).

Study related information, intended study and learning objectives

The peers acknowledge that the School of Energy Systems has already taken measures to ensure that all study-related information about the degree programmes is made accessible to all relevant stakeholders. It has been proved that this is already the case with regard to the study guide. Other than for Electrical Engineering programmes, the English UNI-portal website for the Mechanical Engineering Master's programmes still does not include any hint to the Bachelor's programme, which the peers would strongly suggest despite of the teaching language being Finnish. Irrespective of this latter point, the peers are convinced that the programme coordinators are aware of the issue of transparency of information

and will ensure the easy accessibility of the study-related information on the information channels of the university. They therefore would opt for dropping a respective recommendation proposed originally.

Furthermore, the peers laud that the programme coordinators of the Master's programme in Electrical Engineering have sketched already some exemplary specialization profiles (Solar Economy, Control Engineering in Industrial Electronics, Electrical Drives). It would be certainly worthwhile adding them to the UNI-portal. A respective recommendation is maintained as a reminder for the re-accreditation procedure (see below, chap. E, E 3).

2. The degree programme: structures, methods and implementation

Criterion 2.1 Structure and modules

Evidence:

- Sec. 44 University Act [Assessment and recognition of study attainments]; available on the internet at: http://www.finlex.fi/en/laki/kaannokset/2009/en20090558.pdf
- Sec. 27 University Regulations on Education and the Completion of Studies as of 22 June 2016; available on the internet at: https://uni.lut.fi/en/c/document_library/get_file?uuid=5f89517f-8e4c-4b34-9b9d-45c2b7e7f8be&groupId=10304
- Recognition of Prior Learning and Credit Transfer (Provision of LUT as of 1 September 2014); available on the internet at: https://uni.lut.fi/en/c/document_library/get_file?uuid=ad62478e-be32-45f9-953a-a5b6323e177c&groupId=10304
- Curriculum Tool for each degree programme; Appendices 4 – 9 to the SAR (study plan including learning objectives-course matrix, distribution of courses per semester, teaching and assessment methods)
- Study Guide for each degree programme; Appendices 11 – 16 to the SAR (including course descriptions); available on the internet at: https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=101&Org=16194548&KohtTyypHierAuk=1 (Ba Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=95&Org=16194548&KohtTyypHierAuk=1 (Ba Mechanical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=127&Org=16194548&KohtTyypHierAuk=1 (Ma Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=128&Org=16194548 (Ma Mechatronic

System Design); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=129&Org=16194548&KohtTyypHierAuk=1 (Ma Welded Metal Structures); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=130&Org=16194548&KohtTyypHierAuk=1 (Ma Sustainable Production in Mechanical Engineering)

- Performance of Programmes Indicators; Appendix 18 to the SAR
- Alumni Career Survey - Master's graduates 2009; Appendix 20b to the SAR
- LUT Course feedback questionnaire; Appendix 21 to the SAR
- Statistics on Student Exchange 2013-2016; Appendix 19 to the SAR
- Respective chapter of the SAR
- Audit discussions

Preliminary assessment and analysis of the peers:
For the study programmes under review LUT uses the familiar terminology of "modules" and "courses" in a somewhat uncommon way: "Courses" are referred to as reference units, while the term "module" comprises a set of thematically closely linked courses. Taking this into account, all degree programmes under review can be considered appropriately composed of courses in terms of self-contained teaching and learning units.

The structure of the Bachelor's programmes (A. General studies, B. Language and communication studies, C. Intermediate specialisation studies - compulsory, D. Intermediate specialisation studies - elective, E. Minor studies, F. Elective studies) and the number of compulsory courses clearly illustrate that the programmes are aiming at a solid and broad basic engineering education. In this respect, a voluminous array of compulsory "general studies" (encompassing mathematics and natural sciences) as well as mandatory "intermediate specialisation studies" (laying the groundwork in the respective disciplinary engineering science) is perfectly reasonable. Nevertheless, with minor and elective studies in each Bachelor's programme, students are also given the opportunity to opt for an individual study profile and for a specialisation, if only to a minor degree.

In comparison, the Master's programmes, although consisting of largely the same categories of courses (A. Core studies, B. Language studies, C. Specialisation studies, D. Minor studies, E. Elective studies), are designed just the other way round by sharply reducing the number of compulsory modules in order to give students more opportunities to choose a suitable specialisation track. Regarding the specialisations in the Master's programmes it is noted that a clearly different approach has been followed by the Master's programmes in

Electrical Engineering and Mechanical Engineering respectively. In the Electrical Engineering Master's curriculum, students can compile a catalogue of courses out of sets of thematically closely related courses ("modules") - apart from compulsory core courses and a number of minor and elective courses, and thus design their individual qualification profile. In the Mechanical Engineering Master's curriculum, the splitting up of one stand-alone Master's programme Mechanical Engineering in three independent, self-sustained Master's programmes effectively is meant to leave the decision for one of the programmes to the students as their major curricular choice, while, in turn, the curriculum of each of the specialties (Mechatronic System Design, Welded Metal Structures, Sustainable Production in Mechanical Engineering) is largely fixed. Thus, apart from identical core studies with a volume of 34 ECTS points, the margin of specialisation-related courses in the Mechanical Engineering degree programmes is considerably small, in fact allowing students to choose minor studies and electives worth 20 ECTS points each. It remains to be seen whether the graduates of these programmes fit into a diversified job market in the Mechanical Engineering sector. The performance figures provided in the SAR (employment rates, correspondence between education and the competence requirements at work, average salary) do not allow a meaningful judgement in this respect, since they are obviously but misleadingly deduced from the results originally collected for the former Mechanical Engineering Master's programme.

As Bachelor's and Master's students are generally responsible for planning their individual studies, particularly regarding minor and elective studies in the Bachelor's programmes and, additionally, specialisation studies in the Master's programmes, it is highly appreciable and of utmost importance that the general study guidance organised by "Study Services" *inter alia* include support in making up the personal study plan (PSP) and monitoring the study progress of each student according to his/her plan.

Laboratory courses and industry internships as part of the curriculum of the Bachelor's and the Master's programmes (with the internship mandatory in the Master Electrical Engineering, but only elective in the Master's programmes in Mechanical Engineering) principally ensure that students acquire the skills and competences necessary to apply engineering knowledge in solving work-related tasks and in dealing with workplace-related situations. As regards the laboratories, industry partners generally lauded the students' application-oriented education and capability to apply engineering knowledge and tools in engineering practice. Admittedly, the peers' impression of the laboratory equipment- as far as can be judged from the inspection during the onsite visit - has been less favourable altogether, although the assessment will have to be nuanced for the Bachelor's and the Master's programmes as discussed in a subsequent section of this report (see below sec. 4.3).

It is positively taken into account that representatives of the industry partners appear to highly esteem the mandatory internships in the degree programmes (especially in the Bachelor's programmes). From their perspective, the internships are well suited to introduce students to workplace practices and processes, to prepare thesis works which often are also conducted in cooperation with the companies, and, not least, to establish ties with potential employees. Principally, peers agree with this appraisal, thereby highlighting the importance of industrial placements for engineering students, when issues like employability at large and applicability of engineering knowledge and skills in particular come to the fore. Against this background, it is appreciable that - according to the information available - the industrial placements ("work internship") are adequately integrated into the curriculum, supervised by teaching staff of the School of Energy Systems, and properly structured through learning outcomes and defined work activities, including an obligatory report about their workplace activities which students are requested to submit. However, no binding regulation apart from the respective course description contributes to the Schools responsibility, quality assurance, supervision and counselling of the work internship. Additional information concerning the regulation of and provisions for the "work internship" should be given before a final assessment of the peers on this issue.

In this context, it is also noticed that a work internship must take a full-time employment of at least four weeks in a programme-related company in order to be approvable. This is to say, that the two ECTS credit points attributed to the mandatory industrial placement in the Bachelor's programmes as well as in the Master's programme Electrical Engineering do cover only a part of the workload students have to bear for it (see the following section for further details and an assessment).

There are provisions in place for the recognition of academic achievements acquired at other (Finish or international) universities and also for the recognition of prior learning in general outside LUT, e.g. learning at work). The procedure of recognizing academic achievements and other prior learning is well formalized. Processes for the assessment, the information of students, and the internal documentation and registration are defined and peers have received the impression that these processes are, in principle, working well. It should be noted that the provisions set for the recognition of academic achievements and prior learning are clearly oriented towards the acquired skills and competences and also foresee that negative decisions have to be reasonably substantiated in writing vis-à-vis the applicant.

The internationalisation strategy of the University is convincingly followed through a multitude of exchange partnerships with other universities aiming at raising student mobility (e.g. within the framework of the European ERASMUS programmes), double degree pro-

grammes as well as an increasing number of degree programmes taught in English (particularly Master's programmes, as is the case with the degree programmes under review). Statistical data on international student mobility, although not detailed for the Bachelor's and Master's level respectively, illustrate that a (relatively small) share of students in the Electrical Engineering as well as in the Mechanical Engineering programmes are engaged in the international student exchange. Apparently, students are advised and supported in studying abroad. It is also regarded supportive that students are recommended to conclude learning agreements in advance which normally ensures that courses taken abroad fit into their studies at LUT.

Criterion 2.2 Work load and credits

Evidence:

- Relevant Chapter of the SAR
- Sec. 15 University Regulations on Education and the Completion of Studies as of 22 June 2016 (1 credit/26 h; 60 credits per year/ca. 1600h)
- Curriculum Tool for each degree programme; Appendices 4 – 9 to the SAR (study plan including distribution of workload per study period and semester)
- Study Guide for each degree programme; Appendices 11 – 16 to the SAR (including course descriptions); available on the internet at: https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=101&Org=16194548&KohtTyypHierAuk=1 (Ba Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=95&Org=16194548&KohtTyypHierAuk=1 (Ba Mechanical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=127&Org=16194548&KohtTyypHierAuk=1 (Ma Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=128&Org=16194548 (Ma Mechatronic System Design); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=129&Org=16194548&KohtTyypHierAuk=1 (Ma Welded Metal Structures); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=130&Org=16194548&KohtTyypHierAuk=1 (Ma Sustainable Production in Mechanical Engineering)
- LUT Course feedback questionaire, Annex 21 to the SAR
- Audit discussions

Preliminary assessment and analysis of the peers:
It is recognized that LUT has adopted the ECTS system for the degree programmes so as to reasonably design the order and sequence of courses as well as the distribution of student workload per study period, semester and study year. It also appears to be plausible that courses in the Bachelor's programmes are, in principal, smaller than those in the Master's programmes (3 to 6 ECTS credit points on average) and that, at the same time, Bachelor's courses include more classroom teaching than Master's courses, which are more often based on varying teaching methods and to a greater extent on independent self-study time of students.

Furthermore, concerning the Bachelor's programmes, it is considered reasonable that introductory courses or the Bachelor's seminar are typically awarded only 1 or two ECTS credit points. Regarding the "work internship" however, as has been mentioned above, the allocation of only two ECTS credit points does by no means adequately reflect the actual workload of students for their work in the company. The heads of the degree programmes and the industrial partners as well do subscribe to this statement, all the more so, since - according to the course description of the "work internship" - a four week fulltime employment in a related company, usually to be scheduled during the semester break, is required for approval. Thus, only a small fraction of the actual student workload in the industrial placement is credited. More to the point, it is clear from the onset that the workload assigned for the first two ECTS credits is not meant to cover the ability "to apply and generalize knowledge and skills acquired during the course of studies in [the student's] own field" as an objective reserved solely for the Master's programmes. Acquiring and proving this ability might be, to an ever increasing extent, reflected in the award of up to 10 ECTS credit points for the industrial placement in the Master's programmes. Considering the markedly more limited learning objectives defined for the industrial placement in the Bachelor's as compared with the Master's programmes, the two ECTS credit points appear to be acceptable. After all, peers conclude that the work internships regularly conducted during the semester break do not overburden the students and/or hinder their study progress. If this can be guaranteed, there is no relevant accreditation requirement urging higher education institutions to fully include the student's workload in the companies during his/her placement.

Peers positively noted that the students' workload is monitored on a regular basis (the Course feedback questionnaire entails a question asking about the workload spent for courses of equal ECTS numbers). Asked about their judgment, students' generally confirm that the ECTS credit point distribution overall can be considered adequate - even admitted that from their perspective the credit point award might be adapted occasionally in order to more realistically reflect demanding exercises and homework. In this regard however,

peers assume that the monitoring mechanism with a view to the workload of courses will effect changes should complaints be voiced or significant discrepancies come to light in the course evaluations. Relevant examples in the SAR and in the audit discussions contribute to this assumption.

Another question regarding the issue of the students' workload relates to the distribution of workload per semester and, eventually, to study periods, as each semester is itself divided up into two study periods of seven weeks duration each. As to that the only reference source is the Curriculum Tool provided for each degree programme. But only the study plans for the Electrical Engineering programmes do illustrate a valid picture of the workload distribution by indicating the workload when it actually occurs, irrespective of the duration of a course. Thus the exemplary study plan for the Bachelor's programme shows a relatively balanced workload not only between the semesters but also between the study periods within the semesters. In the Master's programme, the SAR admits a somewhat uneven distribution of the workload between the periods, particularly in the second semester of the second study year. Peers therefore explicitly support the announcement in the SAR (p. 37) to move courses to other periods in order to arrange for a better workload balance.

Regarding the study plans of the Mechanical Engineering programmes it is virtual impossible to get a meaningful overview of the actual workload allocation per period, semester and study year, because the workload is consequently allocated to the very study period the ECTS credit points are formally assigned (i.e. after completion of the course), independent of the actual duration of the course. Thus, the aggregated numbers per period and per semester are blurred and misleading. On this basis, a well balanced workload distribution in both the Bachelor's and the Master's programmes in Mechanical Engineering as stated in the SAR (p. 37) can hardly be validated. The peers therefore ask the heads of the Mechanical Engineering programmes to provide study plans which reflect the actual workload of students in each period and semester.

Criterion 2.3 Teaching methodology

Evidence:

- Relevant chapter of the SAR
- Study Guide for each degree programme; Appendices 11 – 16 to the SAR (module descriptions); available on the internet at: https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=101&Org=16194548&KohtTyypHierAuk=1 (Ba Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=95&Org=16194548&KohtTyypHier-

Auk=1 (Ba Mechanical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=127&Org=16194548&KohtTyypHierAuk=1 (Ma Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=128&Org=16194548 (Ma Mechatronic System Design); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=129&Org=16194548&KohtTyypHierAuk=1 (Ma Welded Metal Structures); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=130&Org=16194548&KohtTyypHierAuk=1 (Ma Sustainable Production in Mechanical Engineering)

- Curriculum Tool for each degree programme; Appendices 4 – 9 to the SAR (study plan including teaching and assessment methods)
- Audit discussions

Preliminary assessment and analysis of the peers:
Reportedly, teaching methods applied in the Bachelor and Master programmes under review include lectures, classroom and laboratory exercises and assignments, project work and seminars. In addition to these more traditional methods of instruction, online courses are offered to a certain extent, and peers strongly suggest maintaining and further developing this method.

Lectures and exercises are the most common teaching methods, but many courses display a greater variety with students taking a more active role. The peers welcome the distinguished description of the applied teaching methodology in the module descriptions. In their perception these descriptions convincingly demonstrate that the teaching methodology is planned according to the learning outcomes of a module. The peers notice an adequate balance between attendance-based learning and self-study. They also appreciate the team and group work examples which show that a number of non-technical social skills are being trained in the programmes. The students are being familiarised with independent academic research in the Bachelor's or Master's Thesis (cf. for further assessment sec. 3).

In summary, the peers judge the teaching methods and instruments to be suitable to support the students in achieving the learning outcomes.

Criterion 2.4 Support and assistance

Evidence:

- Self-Assessment Report 2017: Bachelor's and Master's Programmes in Energy Technology and Environmental Technology, Lappeenranta University of Technology

- LUT general Information: http://www.lut.fi/web/en/get-to-know-us;jsessionid=2EA08C15B5B663BD5E784FCF2FDDAF39.wwwlut2, 10.04.2017.
- LUT UNI-Portal: https://uni.lut.fi/en/web/lut.fi-eng/home, 10.04.2017.

Preliminary assessment and analysis of the peers:
The peers examine the general information about LUT on the website as well as the course related websites; the UNI portal provides general information concerning studies at LUT and specific information regarding the degree programmes. The peers agree that a lot of general information about the different degree programmes is available; information about the Finnish programmes is only available in Finnish. The peers think that this is plausible as students who want to study theses programmes need to have a good command of Finnish. Interested stakeholders are able to obtain information about different administrative processes as well as about the programmes themselves. However, the information delivered on the UNI portal is difficult to find on the subject-specific websites, thus impairing the transparency of the relevant information. The study guide, for example, can be found on the UNI-Portal, but neither this nor the study guide itself is clearly indicated on the subject-specific website. Thus, the latter will be difficult to access for anyone searching for it on those websites. The peers strongly advise the responsible programme coordinators to provide all relevant information on the subject-specific websites as well.

Apart from this, LUT provides support and assistance throughout the life-cycle of a student. Each student at LUT has an electronic personal study plan (PSP) that is based on the degree structure described in the study guide. The first version of the PSP is designed in accordance with the study counsellor at the beginning of the studies and is updated regularly. Specially educated students act as “peer-tutors” and help freshmen throughout the acclimatization period at LUT. Even for the further study progress the peer-to-peer principle plays an important role in LUTs support system: For example, advanced Students provide as so called “Study-Advisors” fellow students with guidance even in later stages of their education. So called “Study counsellors” are providing in-depth guidance in preparing the personal study plans. “Teacher Tutors” help students in the selection of elective course and minor subjects. Problems related to specific courses/modules can be addressed to the competent lecturers at any time. The students emphasise that they are highly satisfied with the support measures at LUT and that they appreciate the “open door” policy of the staff members. There are conflict solution processes in place if there are disagreements.

The auditors conclude that LUT makes adequate resources available to provide individual assistance, advice and support for all students. The peers highlight that the allocated advice and guidance, namely the tutors and advisors, assist the students in achieving the learning outcomes and in completing the course within the scheduled time.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 2:

Taking into account the statement and additional information of the programme coordinators, the peers consider the specifications of the above mentioned criterion as *largely fulfilled*. However, there are still some arrangements / provisions regarding the internship and the distribution of the student's workload which require improvement.

Work Internship

Concerning the internship, the peers have been assuming that these generally require to be conducted in a study-related field. Contrary to that, the "Internship guidelines" which have been submitted along with the statement of the School of Energy systems clearly state that this assumption does only apply for the Master's programmes but not for the Bachelor's. Thus, the "Guidelines" explicitly state for the Bachelor's programmes that "the work does not need to be related to the degree or your field studies". The comparably short duration of the mandatory work internship in the Bachelor's degree programmes could by itself cause concern whether it is conducive to acquiring the intended study and learning objectives. However, the peers would accept such an approach offering first insights into the world of professional work, if these work life experiences are to be made in workplaces closely related to the students' fields of study at least. Thus, they suggest adding a requirement for this purpose (see below, chap. E, A 6).

A new course on labour market, working life and job search for the Bachelor's degree programmes, as planned by the School of Energy Systems in cooperation with the Career Services of LUT, might be supportive in enlarging the students' career skills and competences. The peers explicitly encourage the intended implementation of these courses.

Workload distribution, Master's degree programmes

The review of the workload distribution in the Mechanical Engineering degree programmes according to the actual workload per period and semester has also been found helpful. As in the Electrical Engineering Master's programme, it clearly indicates significant imbalances in the workload distribution in all three Mechanical Engineering Master's programmes, predominantly - again in concordance with the Electrical Engineering Master's programme - in the second study year of the programmes. Peers deem a more balances workload allocation necessary in order to avoid overburdening the students - as has been already announced for the Electrical Engineering Master's programme. Consequently, they suggest supplementing an additional requirement for the Master's programmes (see below, chap. E, A 8).

3. Exams: System, concept and organisation

Criterion 3 Exams: System, concept and organisation

Evidence:

- Study Guide for each degree programme; Appendices 11 – 16 to the SAR (including course descriptions); available on the internet at: https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=101&Org=16194548&KohtTyypHierAuk=1 (Ba Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=95&Org=16194548&KohtTyypHierAuk=1 (Ba Mechanical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=127&Org=16194548&KohtTyypHierAuk=1 (Ma Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=128&Org=16194548 (Ma Mechatronic System Design); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=129&Org=16194548&KohtTyypHierAuk=1 (Ma Welded Metal Structures); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=130&Org=16194548&KohtTyypHierAuk=1 (Ma Sustainable Production in Mechanical Engineering)
- Curriculum Tool for each degree programme; Appendices 4 – 9 to the SAR (study plan including teaching and assessment methods)
- Sec. 15 University Regulations on Education and the Completion of Studies as of 22 June 2016 (1 credit/26 h; 60 credits per year/approx. 1600h)
- Performance of Programmes Indicators; Appendix 18 to the SAR
- Final Thesis Instructions; available on the internet at: https://uni.lut.fi/en/c/document_library/get_file?uuid=5dece119-023c-4b63-9727-ded1b82fba14&groupId=10304
- On-site inspection of samples of examinations as well as Bachelor's and Master's theses
- Audit discussions

Preliminary assessment and analysis of the peers:

The methods of assessment in use for the degree programmes in Electrical and Mechanical Engineering are, in principal, considered suitable to individually measure the extent to which students have actually achieved the set learning outcomes. Though written examinations are - as the SAR concedes - predominant in the Electrical Engineering programmes,

there are also some courses in which the evaluation is based on either continuous assessment or some other assessment method like online or home assignment or peer-reviewed project work. In the Mechanical Engineering programmes, the variety of applied examination methods altogether appears to be wider, ranging from oral examinations to learning diaries to reports of project and seminar works and poster presentations - apart from and instead of more traditional written exams. Nevertheless, written examinations do play a significant role in the Mechanical Engineering programmes as well. Anyway, regarding the evaluation of courses the School and its teaching staff apparently follow the principle that different evaluation methods suit different learning outcomes. Any consideration of the still exceptional importance of written exams in either programme has to take into account that this significantly resonates with the students' preferences.

The results of a sample of examinations inspected during the onsite-visit have been found generally adequate in terms of requirements and qualification level in case of the Master's programmes. In a row of Bachelor's exams, however, the assignments and results have been found below Bachelor and, significantly, in a number of cases not even fitting the intended learning outcomes as described in the respective course description. This applies for the Bachelor's programmes Electrical Engineering and Mechanical Engineering alike. Wondering about the reasons for this observation, the interrelation of defined learning outcomes, content description and exam requirements comes up as a starting point. Occasionally, a wide gap between the intended course learning objectives on the one side and unfitting exam assignments on the other is recognizable. In other cases, a set of widely unspecified or very broadly defined learning outcomes and/or contents hardly provides a reasonable measure for the learning achievements. In one or the other form connected with that, an inadequate rigour in the conduct of examinations might lay at the basis of the findings. And it is presumably attributing to all of this that the personnel predominantly teaching in the Bachelor's programmes - characteristically contradicting the outspoken strategy of the School of Energy Systems- is not the most experienced professors in the relevant field but mainly their assistants and staff (as to this see sec. 4.1).

All in all, the peers consider immediate steps necessary to ensure an adequate quality level of the exams throughout the Bachelor's programmes under review. Consequently, a process should be designed and implemented to systematically and regularly monitor the interrelation and consistent alignment of intended learning outcomes, contents and exams of each course at the Bachelor's level.

The inspection of final theses has caused similar concerns. While the Master theses, in general, revealed an adequate quality level in relation to the scientific standard for the Master's degree, the Bachelor theses closely examined during the onsite-visit in general only barely keep up with the quality standards of the Bachelor level. From the peers' point of

view, there is no simple explanation for this finding. Premature conclusions need to be cautioned, because the sample of theses has been by no means representative. Otherwise, the peers' inspection leads to comparable results for both Bachelor's degree programmes. Peers assume that the relative devaluation of the Bachelor's degree – as compared to the Master's degree, which is presented more or less as the standard degree of LUT on its websites as well as in its study-related regulations – might be a key explanation factor. Thus, sec. 36 of the "University Regulations on Education and the Completion of Studies" explicitly states that the Bachelor's degree "must be completed *before the approval of the Master's thesis topic*" which, in turn, means that students of LUT can transfer to a Master's programme without having finished their Bachelor's degree yet.[7] It is appreciable – as has been pointed out earlier– that the School of Energy Systems is purposively recommending to its students that they should complete their Bachelor's degree first. But there is still no binding obligation to do so. As a consequence, students who are in any case willing to continue their studies with a Master's programme and, moreover, are already admitted to the programme might see the Bachelor thesis as a minor preparation work. And it might be indicative of such an understanding that supervisors/instructors of the Bachelor thesis need to have a higher university degree only, while the first examiner of the Master thesis is required to be a LUT professor, a docent or associate professor (see Sec. 32 and 36 of the "University Regulations on Education and the Completion of Studies"). Presumably, it also negatively affects the Bachelor thesis that there are strict and very detailed "Final Thesis Instructions" which, however, apply in the first instance for the Master thesis. In a vague, non-binding phrase the introduction to the "Instructions" states that "They *may* also be used, *where applicable*, for Licentiate theses, Bachelor theses and written assignments". In order to generally raise the quality of the Bachelor theses, the peers consider it of high importance that binding scientific standards as set in the "Instructions" should be phrased and put into force specifically for the Bachelor thesis. It goes without saying that all future steps taken to strengthen the idea of the Bologna two-cycle study system and the clear separation between the Bachelor's and the Master's programmes are considered supportive in confirming the value of the Bachelor's studies and, along with that, the Bachelor thesis.

[7] Somewhat contradicting in this respect is sec. 7 No. 2 of the "Universities Act" according to which "The Master's degree is taken after completing a Bachelor's degree or equivalent studies". However, the wording does not principally rule out LUT's provision. The above cited article may then apply to external students primarily, while students of LUT already admitted into the university for both Bachelor's and Master's studies are allowed to start their Master's studies and requested to complete the Bachelor's degree before obtaining the approval for the Master's thesis topic (see also Final thesis instruction as of 25 January 2017, p. 1).

Regarding the schedule, conduct and organisation of the assessments at large, transparent rules have been defined, duly published and are obviously working well. Students are informed about the dates and methods of examinations in due time and multiple exam dates allow for the planning of exams and re-sits without overlaps, thus supporting a continuous study progress without undue delay.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 3:

The peers consider the demands of the above mentioned criterion *fulfilled fully* in the Master's degree programmes, but *to a significant lesser extent* in the Bachelor's degree programmes. They came to the conclusion that the achievement of the intended learning outcomes in the Bachelor's degree programmes needs to be more convincingly evidenced through the instruments and methods of assessment (exams, Bachelor thesis).

Examinations

The peers highly value the efforts which have been undertaken since the previous accreditation in terms of aligning intended learning objectives and curricular contents with the respective assessment methods in general and applying a diversity of assessment methods in the case of the Mechanical Engineering programmes in particular. However, as has been pointed out in several parts of this report, the onsite inspection of samples of examinations in the Bachelor's degree programmes reveal often meagre results in terms of evidencing the intended learning outcomes according to the course / module descriptions. They assume that a more structured and systematically followed monitoring process for this alignment will be supportive to generally proof the achievement of the intended learning outcomes. The peers propose to maintain a requirement that has been originally proposed to this end (see below, chap. E, A 5).

Bachelor's Thesis

The peers acknowledge that the School of Energy Systems has taken precautions in an attempt to value the Bachelor thesis in its own right (Bachelor's seminar, Bachelor's thesis Assessment matrix, in case of the Mechanical Engineering Bachelor's programme also: the assessment by different persons in charge). Partially contrasting this, however, the inspection of a series of theses of both Bachelor programmes again in many instances reveal results hardly or even outright not keeping up with the quality standard at the Bachelor's level. As has been suggested throughout the report, this impression might be traceable to different reasons, often interlinked with each other. And a sample of Bachelor's theses - as in the case of a sample of examinations - by definition does not represent the whole picture. Nevertheless, the peers have the impression that the School of Energy Systems should

intensify its efforts to establish the Bachelor's thesis as a keystone of the first-cycle degree and to raise the awareness of this issue. The peers assume that a conscious development and implementation of scientific standards for the Bachelor thesis - which already exist for the Master's thesis - will promote this idea and thus contribute to upgrading the general quality of the Bachelor's theses (see below, chap. E, A 7).

4. Resources

Criterion 4.1 Staff

Evidence:

- Chapters „Staff"and "Research activities and laboratories/research groups" in the SAR
- Research activities of the School of Energy Systems; detailed information available on the internet at the LUT Research Portal: https://research.lut.fi/converis/portal?lang=en_GB
- Trailblazer – LUT Strategy 2020 – Lappeenranta University of Technology; Appendix 1 to the SAR
- Staff handbook; Appendix 17 to the SAR
- Regulations of Lappeenranta University of Technology; Appendix 2 to the SAR
- Audit discussions

Preliminary assessment and analysis of the peers:

In principal, the peers consider the teaching staff of the School of Energy Systems which contributes to the Bachelor's and Master's programmes in Electrical Engineering and Mechanical Engineering adequate in number and qualification. A nearly equivalent number of full-time employees (67 in the competence area of Electrical Engineering; 66 in the competence area of Mechanical Engineering) and professors (full and Associate/Assistent professors combined: 16 in the Electrical Engineering field; 13 in the Mechanical Engineering field) confirms to this assumption.

It is acknowledged that the School not only emphases a close link between the research and teaching activities of the staff, but also maintains that a transfer of the research results into the teaching of the programmes shall always be looked after. To the extent that such transfer could be and has been achieved, i.e. through Master theses conducted in the

framework of research projects, positive side effects on the quality of the related programmes (particularly the Master's programmes) may be conclusively inferred.

Taking into account the University's strategic focus areas "Clean Energy" and "Circular Economy", it seems plausible that – as the University's management and the School jointly confirm – the staff capacity will be consolidated in the medium and long term – adaptations in the engineering expertise according to technological developments notwithstanding.

However, the peers have also received the impression that teaching in the Bachelor's programmes, and especially in core subjects of these programmes, is often left to the staff of professors, assistant professors or doctoral students. This sharply contradicts the declared objective of the School that teaching in the Bachelor's programmes should be a major task of the most experienced professors in the respective fields of competence. Furthermore, this observation to a certain degree reflects the marginalization of the Bachelor's programmes and, to a certain extent it might also explain the shortcomings regarding exams and Bachelor theses (see sec. 3). On the other hand, the peers take note of the mostly positive feedback of students when asked about the didactical as well as subject area-related competences of the teaching staff. Nevertheless, the heads of programmes are encouraged to take appropriate measures in order to ensure that fundamental and core courses of the Bachelor's programmes are taught by experienced and well-qualified teaching personnel on a regular basis.

Criterion 4.2 Staff development

Evidence:

- Chapter „Staff development" in the SAR
- Audit discussions

Preliminary assessment and analysis of the peers:

From the information available, the peers can see that the university provides support and opportunities for the development of skills both for new employees and for those who have been working at LUT for a longer time. The university has convincingly argued that it provides opportunities for the development of the professional skills for its personnel, encompassing both specialised scientific and pedagogical skills. According to the SAR and confirmed during the audit discussion with the teaching staff, a significant number of staff members of both the Electrical Engineering and the Mechanical Engineering branch have already participated in training courses in and outside the university.

In this respect, it is also generally appreciated that staff development has been made an issue of university strategy and action plans which define the focus areas of human resource development on a regular basis.

Criterion 4.3 Funds and equipment

Evidence:

- Chapter „Funds and equipment“, “Teaching facilities”, “Laboratories of Electrical Engineering”, “Laboratories of Mechanical Engineering” of the SAR
- Audit discussions

Preliminary assessment and analysis of the peers:

All in all, the peers consider the financial basis as laid out in the SAR and in the audit discussions sufficient to continue and further develop the degree programmes. Regarding the importance attached to the research activities of the School of Energy Systems, it is well recognized that a considerable proportion of the funds available to the Electrical Engineering field as well as the Mechanical Engineering area (more than 50% in each branch), can be traced to research projects. At the same time the principal division of the annual budget in two components - an internal budget mainly for teaching activities and external funding for research activities - ensures a solid foundation for and the continuity of the programmes.

The SAR and the heads of the programmes have repeatedly underlined the importance of the research capacity of the Electrical and Mechanical Engineering research groups for maintaining and developing the quality of the degree programmes under review. Indeed, the audit talks shed light on the close ties between the university and - predominantly - its industrial partners whose representatives confirmed the successful collaboration in application-oriented research as well as in the Bachelor’s and Master’s education (industrial internships, project works, final theses). Thereby, particularly external Master theses have apparently come to reflect the combination of teaching and research.

Through highlighting the significance of high-quality research projects, the university and School of Energy Systems have nourished expectations of state-of-the-art laboratory capacities capable of keeping up to these challenges. However, the onsite-inspection of the laboratory equipment from the perspective of the peers revealed a somehow disappointing picture in that respect. Generally speaking, the peers conclude a mismatch between the

claim of excellence on the one side and the laboratory facilities and efforts to have experienced staff teaching the students on the other. Peers found that a structured and systematic approach to laboratory teaching/exercises was not clearly visible. They missed a convincing set of practical projects showing how the lab concept fits into the goals and claims of the degree programmes.

These observations are closely connected to the physical status quo of the lab facilities the peers have inspected. The laboratories for the Electrical Engineering programmes seen so far by the peers can hardly be considered as the basis for advanced research, particularly in the specialisation fields of the Master's programme, let alone PhD-relevant research topics. Thus, for instance, laboratory equipment on wave propagation, semiconductor devices, and signal processing, even in the context of energy engineering, but also on embedded systems, power systems, power transmission systems and grid simulation was not evident. Similarly, the main laboratories used for the Mechanical Engineering programmes clustered around research groups largely paralleling the new Master's programmes in Mechanical Engineering do hardly live up to the demands for an advanced research capacity. The laboratory equipment in the field of Welded Metal Structures seems to be most developed, while a laboratory infrastructure for the Master's programmes Mechatronic System Design and Sustainable Production in Mechanical Engineering has been found barely discernible.

To be sure: The peers very much appreciate the research efforts of the School of Energy Systems and, in particular, the practiced educational co-operation with the laboratories in each engineering field and the research groups clustered around them respectively. They also acknowledge that basic infrastructure for the Bachelor's and Master's degree programmes is recognizable. But in order to more effectively put into practice the said combination of teaching and research for the betterment of the degree programmes, the laboratory infrastructure needs to be build up as a whole. Thus, peers consider it necessary that the School of Engineering provides a concept for upgrading the laboratories which also clarifies how the set laboratory programme is aligned with the educational goals and learning objectives of the degree programmes. Additionally, evidence should be proven that initial steps for the implementation of this concept have been taken.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 4:

The peers consider the demands concerning the *staff resources fulfilled*. Concerning the equipment, in particular the *laboratory equipment*, they consider the specification of the relevant criterion *not yet fulfilled satisfactorily*.

Laboratory equipment

It has been argued in detail in the preliminary evaluation why the state of the laboratory situation as inspected during the onsite-visit has been found insufficient regarding the intended study and learning objectives. As to that, the statement of LUT School of Energy Systems points out with regard to the Mechanical Engineering labs that large parts of the laboratories have been and are still under construction and therefore have not been open for inspection. The peers are told that those laboratories will not only be relocated in new and modern premises but are, for the major part, already state-of-the-art laboratories or will be renewed otherwise. The peers acknowledge this clarification but underline at the same time that no evidence has been provided whatsoever - neither for the Mechanical Engineering programmes nor for the Electrical Engineering programmes - that could serve as a basis for a re-evaluation of the physical status quo of the laboratory equipment available for the programmes under consideration. Regarding the Mechanical Engineering labs, the reported state of the equipment at least needs to be substantiated through additional information, as for instance descriptions of equipment, pictures of lab equipment etc., in order to give peers a chance to gauge whether they actually meet state-of-the-art standards. Likewise, the statement of the programme coordinators does not entail any further information concerning the question of how the formation in the laboratories - apart from their sole physical structure - is integrated into the teaching concept and aligned to the intended programme learning outcomes. The peers therefore confirm a related requirement, originally phrased during the onsite-visit and slightly modified with regard to the laboratories of the Mechanical Engineering programmes which were not accessible at the time (see below, chap. E, A 1).

Teaching staff

Regarding the teaching staff, the peers have gained the impression that the most experienced professors are largely engaged in the Master's degree programmes thus leaving especially the teaching of fundamental and core courses of the Bachelor's degree programmes primarily to less experienced professors or doctoral students. As has been argued, this might be one reason for the stated deficiencies in the Bachelor's programmes amongst others. The peers recommend engaging the most experienced staff into the teaching of the fundamental engineering courses to a greater extent (see below, chap. E, E 2).

5. Transparency and documentation

Criterion 5.1 Module descriptions

Evidence:

- Study Guide for each degree programme; Appendices 11 – 16 to the SAR (including course descriptions); available on the internet at: https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=101&Org=16194548&KohtTyypHierAuk=1 (Ba Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=95&Org=16194548&KohtTyypHierAuk=1 (Ba Mechanical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=127&Org=16194548&KohtTyypHierAuk=1 (Ma Electrical Engineering); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=128&Org=16194548 (Ma Mechatronic System Design); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=129&Org=16194548&KohtTyypHierAuk=1 (Ma Welded Metal Structures); https://weboodi.lut.fi/oodi/vl_kehys.jsp?Kieli=6&MD5avain=&vl_tila=4&Opas=130&Org=16194548&KohtTyypHierAuk=1 (Ma Sustainable Production in Mechanical Engineering)
- SAR and audit discussions

Preliminary assessment and analysis of the peers:

Generally, the School of Energy Systems has presented informative course descriptions for all degree programmes. They regularly entail relevant information on responsible persons, teaching methods and workload, awarded credit points, learning outcomes, course content, admission requirements, and forms of assessment. The learning outcomes of the courses, by and large, correspond to the programme learning outcomes (see above sec. 1.1, 1.3). In most cases they appropriately indicate which knowledge, skills and competences students are expected to achieve when studying the course.

In this context, it needs to be stressed that learning outcomes, content, teaching methods and examinations of courses are to be logically interlinked. It is immediately comprehensible that intended course learning outcomes should be rationalized by the contents of that course. Examinations, in turn, should be suitable in terms of form and range with respect to the defined learning objectives (and contents). In this regard – as has been observed in previous sections (see sec. 1.3 and 3) –, course descriptions, particularly in the Bachelor's programmes do contain evident inconsistencies. Some entail unduly generic and comprehensive content descriptions leaving open the question whether they are adequately reflected in more or less precise learning objectives and, if so, whether the achievement of

these learning objectives is realistic. In other cases, the learning objectives and related contents may be considered appropriate, but the examination turns out to be not nearly as demanding as one would have expected on the basis of the course description. It is therefore necessary to carefully monitor the pretended correspondence between learning outcomes, contents and assessments of courses, especially with respect to the Bachelor's degree programmes. The exams need to be in line with the quality standards set by the contents and learning objectives. Peers suggested defining and putting into practice a related process for this purpose (see sec. 1.3 and 3).

In addition to this process-oriented aspect, it would make good sense to check the course descriptions for inappropriate, generic or unduly comprehensive content depiction and update them accordingly.

Furthermore, the peers note that module coordinators in many course descriptions do without giving helpful literature recommendations but only refer to the materials on the MOODLE learning platform. From experience and for preparation purposes, peers suggest giving a couple of literature recommendations in the course descriptions.

Criterion 5.2 Diploma and Diploma Supplement

Evidence:

- Diploma Supplement the degree programmes; DS for the former Master's programme Mechanical Engineering only, missing for the new degree programmes in Mechanical Engineering

Preliminary assessment and analysis of the peers:

Diploma Supplements have been provided for each degree programme with the exception of the new Master's programmes in Mechanical Engineering (Mechatronic Design Systems; Welded Metal Structures, Sustainable Production in Mechanical Engineering). The peers consider the information regarding the qualifications profile of the graduates to be rather generic. Interested stakeholders like other universities or possible employers will not find meaningful information on the subject-specific competences of the graduates. It needs to be underlined here that the information about the learning outcomes of the relevant degree programmes should be both programme-specific and consistent. Therefore, it is suggested to include the more precise and meaningful learning objectives as a significant qualification profile of each degree programme also into the respective Diploma Supplement.

Furthermore the peers have only seen a Diploma Supplement of the former Master's degree programme Mechanical Engineering (as indicated above). Programme-related Diploma Supplements for the new Master's programmes are missing. These are expected to be produced and submitted for inspection in the further course of the procedure, also entailing a detailed depiction of the distinctive learning objectives each.

The auditors also point out that the Diploma Supplement needs to contain detailed information about the educational objectives, intended learning outcomes and the individual performance of the student. Moreover, statistical data according to the ECTS User's Guide in addition to the final grade needs to be provided. This had been recommended in the previous accreditation of the programmes already but has apparently not been fulfilled so far.

Section 23 of the "University regulations of LUT" states that an English Diploma Supplement is issued automatically and free of charge along with the degree certificate and a transcript of records. Sample copies of both the Degree Certificate and the Transcript of Records are not available and should be handed in later for each degree programme under review.

Criterion 5.3 Relevant rules

Evidence:

- Universities Act 558/2009 (Amendments up to 644/2016 included), available on the internet at: http://www.finlex.fi/en/laki/kaannokset/2009/en20090558.pdf
- Government Decree on University Degrees; available on the Internet at: https://www.finlex.fi/fi/laki/kaannokset/2004/en20040794.pdf
- University Regulations on Education and the Completion of Studies; available at: https://uni.lut.fi/en/c/document_library/get_file?uuid=5f89517f-8e4c-4b34-9b9d-45c2b7e7f8be&groupId=10304
- Regulations of Lappeenranta University of Technology; Appendix 2 to the SAR
- Final thesis instructions as of 25 January 2017; available on the internet at: https://uni.lut.fi/en/c/document_library/get_file?uuid=5dece119-023c-4b63-9727-ded1b82fba14&groupId=10304
- Recognition of Prior Learning and Credit Transfer (updated in March 2017); available on the internet at: https://uni.lut.fi/en/c/document_library/get_file?uuid=5dece119-023c-4b63-9727-ded1b82fba14&groupId=10304

Preliminary assessment and analysis of the peers:
Principally, the rules and regulations do contain all relevant regulations with regard to the admission, course, and completion of studies (in the teaching language of the degree programmes). Apart from that, study-related rules, regulations and provisions are apparently put into force and valid.

Moreover, all study-related information is available on the internet, and, with the rare exception of the Bachelor's degree programmes, not only in Finish but also in English. As has been indicated above, programme coordinators should think about likewise translating the relevant information in the Bachelor's programmes into English.

It has also been mentioned already that it is unclear to the peers if there are any binding rules or guidelines governing the work internship. If so, the peers ask for their submission along with the statement of the university.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 5:

The peers consider the specifications with regard to transparency and documentation *partly fulfilled*. Certain aspects of the module descriptions and the diploma supplement do not yet meet the standard.

Module descriptions

It is appreciable that the programme coordinators have been constructively receiving the indications concerning shortcomings in the module descriptions (i.e. alignment of module-related learning outcomes and contents with the respective assessment methods, proper depiction of the contents of modules). Peers propose to impose a requirement for that purpose (see below, chap. E, A 2).

Course descriptions should also encompass an adequate list of relevant literature references as argued in the preliminary assessment of the peers (see below, chap. E, E 1). Regarding the accessibility of study-related information, the additional evidence provided within the statement of programme coordinators has prompted the peers to waive a related recommendation (see above, final assessment to sec. 1).

Degree Certificates, Transcript of Records and Diploma Supplement

Regarding the examples of final documents (Degree Certificates, Transcript of Records) submitted along with the statement of the programme coordinators, the peers observe that the Transcript does entail all necessary information about the individual academic achievements of the graduate. Obviously, the Diploma Supplement contains an only ge-

neric version of the intended learning objectives which should be replaced by the programme-specific version that could be found in the SAR. Also, at least the final grade must be inserted into the Diploma Supplement along with statistical data according to the ECTS User's Guide allowing for a comparison and classification of the individual study success. The peers propose including a requirement to this end (see below, chap. E, A 3).

6. Quality management: quality assessment and development

Criterion 6 Quality management: quality assessment and development

Evidence:

- Chapter „Quality management: quality assessment and development" in the SAR
- Performance of programmes' indicators 2014 – 2016; Appendix 18 to the SAR
- LUT Alumni career survey 2009 graduates (conducted 2014); Appendix 20b to the SAR
- Feedback by the commissioner of the final thesis 2015_LUT; Appendix 20a to the SAR
- LUT Course feedback questionnaire; Appendix 21 to the SAR
- Annual Plan for Education Statistics; Appendix 3 to the SAR
- Audit of Lappeenranta University of Technology 2015 (by the Finnish Education Evaluation Centre); Report available on the internet at: https://karvi.fi/app/uploads/2015/04/KARVI_1515.pdf
- Audit discussions

Preliminary assessment and analysis of the peers:

It is to be recognized at the onset that the university and the School of Energy Systems do have a quality management system in place whose mechanisms have been found functional for the most part.

Besides the internal system of quality assurance which has been developed and established at university, school, programme and course level, LUT apparently has just recently undergone an external institutional evaluation by the Finnish Education Evaluation Centre (2015). Generally and as a summary of its findings, the evaluation report draws a very positive conclusion: "The quality system serves the institution well in ensuring the close connection between strategic goals and action in practice. It is clearly and comprehensively docu-

mented and readily accessible to all those involved." Concerning the definition and implementation of quality processes, the distribution and clear attribution of responsibilities, the establishment of the bodies and working groups at university, school and programme level responsible for monitoring, evaluating, changing and adapting existing degree programmes as well as developing new ones, the peers fully agree to the conclusions of the institutional evaluation. However, none of the degree programmes under review has been under closer scrutiny in the institutional evaluation and neither has the functionality of the quality management processes of the School of Energy Systems (or, for that cause, the responsible organisational units at the time).

At first glance, the combination of gathering relevant data about study conditions, study progress and study success with surveys and evaluations on a regular basis on the one hand and established structures for the analysis and utilization of the results on the other appears to be working well. Notably, this applies to the course evaluations and their follow-up process, as the students' feedback in the audit discussions clearly suggest. Regarding the statistical data base available for the quality management system of the School, the peers' conclusion is less favourable. Cohort-wise student statistics which would have allowed for a more systematic view on the study success (with indicators like student numbers, average duration of study, drop-out rate, graduates in standard period of study, etc.) are not available. The only performance numbers provided (Performance of programmes Indicators 2014 – 2016) are referring to whole study years, thus hindering meaningful findings with respect to the above mentioned success indicators. Other indicators though, such as the "Share of students completing at least 55 ECTS per academic year" which is one of LUT's key benchmark figures, have produced quite interesting numbers. Obviously, the share of students performing well in this benchmark category is significantly low in all degree programmes (roughly 30% in each programme). Exemplarily, these numbers should have prompted a thorough analysis of possible reasons and follow-up measures. But there are neither indications of an in-depth appraisal of the aggregated performance statistics nor for their deliberate use in a structured follow-up discussion. Other statistics are simply useless because they do not differentiate between Bachelor's and Master's programmes ("Feedback by the commissioner of final thesis 2015") or reflect views of an only small portion of Master graduates in a study year not even within the previous accreditation period ("LUT Alumni career survey 2009 graduates").

The peers therefore seriously advise the heads of the degree programmes to device a quality process ensuring a systemic, programme-related monitoring of the study progress as well as its purposive use for the development of the degree programmes. This monitoring process should include meaningful cohort-wise statistical data concerning the graduation

rate, the drop-out rate, the examination failure rate and the duration of study. In addition to that, evidence should be provided that first steps of its implementation have been taken.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 6:

The peers conclude that the quality assurance system does *not yet fully meet the standard*.

Quality assurance system

All in all, they highly value the efforts of the School of Energy Systems to establish an effective quality assurance system for the degree programmes. And certainly, some progress has been made in this regard since the previous accreditation. However, as the programme coordinators admit, a systematic and programme-related monitoring of the study success is still missing. The peers encourage the School to proceed along the direction indicated in the statement. In particular, they consider it necessary that a concept is presented illustrating how a systematic and cohort-wise monitoring of the students' study success is going to be effectively implemented (see below, chap. E, A 4).

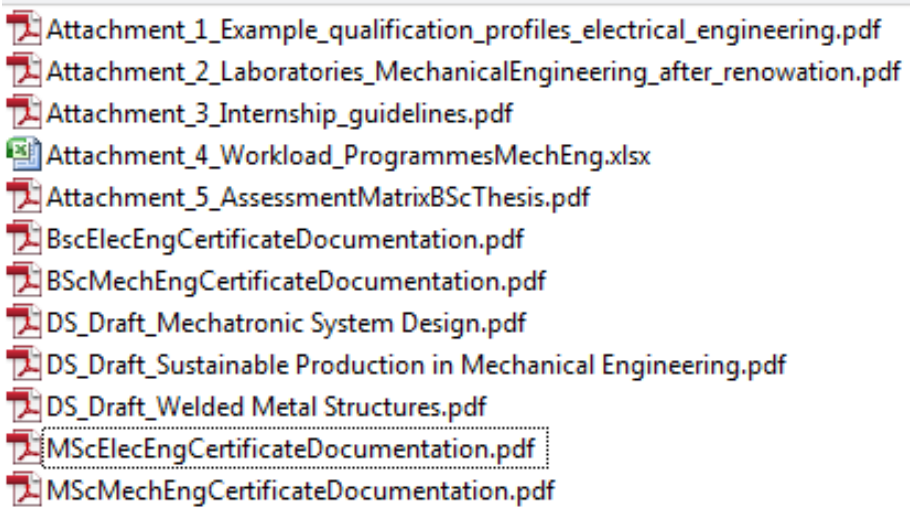
D Additional Documents

Before preparing their final assessment, the panel ask that the following missing or unclear information be provided together with the comment of the Higher Education Institution on the previous chapters of this report:

D 1. All degree programmes: Transcript of Records and Degree Certificate
D 2. All degree programmes: Rules/provisions governing the industrial placement ("work internship"), if applicable
D 3. Bachelor's and Master's programmes in Mechanical Engineering: Study plans illustrating the actual workload distribution per period and semester (for instance, updated "Curriculum Tool")

E Comment of the Higher Education Institution (06.06.2017)

The institution provided a detailed statement as well as the following additional documents :



F Summary: Peer recommendations (13.06.2017)

Taking into account the additional information and the comments given by LUT, the peers summarize their analysis and **final assessment** for the award of the seals as follows:

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ba Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ba Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024
Ma Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ma Mechatronic System Design	With requirements for one year	EUR-ACE®	30.09.2024
Ma Welded Metal Structures	With requirements for one year	EUR-ACE®	30.09.2024
Ma Sustainable Production in Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024

Requirements

All degree programmes

A 1. (ASIIN 4.3) A concept for upgrading the laboratories must be provided and initial steps for its implementation have to be undertaken or, with respect to the Mechanical Engineering programmes, a precise and meaningful account of the existing labs, including a prospect for their further development, has to be presented. Thereby, it must be demonstrated how the formation in the laboratories is supportive to the intended educational goals and learning objectives.

A 2. (ASIIN 5.1) Rewrite the course descriptions so as to give a more precise idea of the contents.

A 3. (ASIIN 5.2) Include the more precise version of the programme-related learning outcomes – as set in the Self Assessment Report – into the respective Diploma Supplement. Provide also statistical data according to the ECTS user's guide in addition to the final grade in the Diploma Supplement.

A 4. (ASIIN 6) Provide a concept for a systemic monitoring of the study progress and its intended use for the development of the degree programmes. This should include meaningful cohort-wise statistical data concerning the graduation rate, the drop-out rate, the examination failure rate and the duration of study. Prove evidence that first steps of its implementation have been taken.

For the Bachelor's degree programmes

A 5. (ASIIN 1.3, 3) Develop and implement a process to systematically monitor the consistent alignment of intended learning outcomes and contents with the assessment of each course at the Bachelor's level.

A 6. (ASIIN 2.1) Make sure that the mandatory internship is related to the student's field of studies.

A 7. (ASIIN 3) Ensure that "Final thesis instructions" with binding scientific standards for the Bachelor's level are in place and followed in order to upgrade the quality of the Bachelor's Theses.

For the Master's degree programmes in Mechanical Engineering

A 8. (ASIIN 2.2) Ensure a more balanced distribution of the student workload per semester concerning, in particular, the second study year.

Recommendations

For all degree programmes

E 1. (ASIIN 5.1) It is recommended to provide an adequate list of relevant literature references in the course descriptions.

For the Bachelor's degree programmes

E 2. (ASIIN 4.1) It is recommended to take appropriate measures ensuring that fundamental and core courses of each programme are taught by experienced and well-qualified teaching personnel on a regular basis.

For the Master's degree programme Electrical Engineering

E 3. (ASIIN 1.1) It is recommended to outline qualification profiles for the main fields of specialization or major module combinations and make them publicly accessible.

G Comment of the Technical Committees

Technical Committee 01 – Mechanical Engineering / Process Engineering (19.06.2017)

Mr. Lichtenberg reports about the accreditation procedure. The Technical Committee discusses the procedure.

Assessment and analysis for the award of the ASIIN seal:

The Technical Committee (TC) takes note of the added explanation in requirement number 1. But the TC thinks that the standard requirement, namely that "LUT has to provide a concept for upgrading the laboratories and initial steps for its implementation have to be undertaken" is focused and precise and does not require any further addendum. Regarding the second sentence of this requirement, the TC suggests to reword it slightly. The TC thinks that requirement 4, demanding a mandatory internship in the field of study does not consider the specific Finnish environment appropriately and rather proposes a recommendation in line with all the other clusters dealing with LUT.

Assessment and analysis for the award of the EUR-ACE® Label:

The Technical Committee judges that the intended learning outcomes of the degree programmes do comply with the engineering specific part of Subject-Specific Criteria of the Technical Committee 01.

The Technical Committee 01 – Mechanical Engineering / Process Engineering recommends the award of the seals as follows:

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ba Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ba Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024
Ma Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ma Mechatronic System Design	With requirements for one year	EUR-ACE®	30.09.2024
Ma Welded Metal Structures	With requirements for one year	EUR-ACE®	30.09.2024
Ma Sustainable Production in Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024

Suggested changes by TC 01:

Proposed deletion of an addendum in requirement 1

A 1. A concept for upgrading the laboratories must be provided and initial steps for its implementation have to be undertaken ~~or, with respect to the Mechanical Engineering programmes, a precise and meaningful account of the existing labs, including a prospect for their further development, has to be presented. Thereby~~, It must be demonstrated how the formation in the laboratories is supportive to the intended educational goals and learning objectives.

Proposed change of requirement 6 into a recommendation

~~A 6. Make sure that the mandatory internship is related to the student's field of studies.~~

E 2. It is recommended to extend the length of the compulsory internship and to demand a connection with the field of studies.

Technical Committee 02 – Electrical Engineering / Information Technology (20.06.2017)

Mr. Wißing, Mr. Schumacher and Mr. Hermes report about the procedure. The Technical Committee discusses the procedure.

Assessment and analysis for the award of the ASIIN seal:

As to requirement number 1 (laboratories and training in the laboratories), it chooses not to follow the Technical Committee 01 suggesting to discard the specification concerning the Mechanical Engineering programmes. The standard requirement does not reflect the somewhat altered situation for these programmes, which the peers have been informed about in the statement of the HEI. Taking this into account, it seems inadequate to require

a concept for the upgrading of the laboratories but rather more precise information about the actual state of the laboratories and their planned further development. It should be indicated in the requirement that the peers have taken note of the HEI's statement in that respect.

With regard to the assessment of the internship, the Technical Committee agrees with the Technical Committee 01 in changing the related requirement into a recommendation for the Bachelor's programmes in line with the other clusters dealing with LUT (see recommendation number E 2). The actual design of the internship seems inappropriate and one might rather doubt whether a meaningful internship (including supervision of the School of Energy Systems as well as an adequate volume of credits) should be mandatory, especially in view of its importance for the employability of the graduates. The Technical Committee also proposes a slight rewording of the recommendation, substituting "length" with "duration".

Besides, the Technical Committee agrees with the recommended resolution without further modification.

Assessment and analysis for the award of the EUR-ACE® Label:

The Technical Committee judges that the intended learning outcomes of the degree programmes do comply with the engineering specific part of Subject-Specific Criteria of the Technical Committee 02.

The Technical Committee 02 – Electrical Engineering / Information Technology recommends the award of the seals as follows:

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ba Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ba Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024
Ma Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ma Mechatronic System Design	With requirements for one year	EUR-ACE®	30.09.2024
Ma Welded Metal Structures	With requirements for one year	EUR-ACE®	30.09.2024

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ma Sustainable Production in Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024

Suggested changes by TC 02:

Suggested textual modification in requirement 1

A 1. (ASIIN 4.3) A concept for upgrading the laboratories must be provided and initial steps for its implementation have to be undertaken or, with respect to the Mechanical Engineering programmes, a precise and meaningful account of the existing labs, including a prospect for their further development, has to be presented. Thereby, it must be demonstrated how the ~~formation~~ training in the laboratories is supportive to the intended educational goals and learning objectives.

Suggested change of requirement 6 into a recommendation, including a textual modification

~~A 2. Make sure that the mandatory internship is related to the student's field of studies.~~

E 2. It is recommended to extend the ~~length~~ duration of the compulsory internship and to demand a connection with the field of studies.

H Decision of the Accreditation Commission (30.06.2017)

Assessment and analysis for the award of the subject-specific ASIIN seal:

The Accreditation Commission intensively debates the quality level of the Bachelor programmes in general, and with specific regard to the at least in certain instances still unfinished implementation of the Bachelor degree as a first cycle scientific degree on its own (exams, Bachelor theses). Thus far, it fully complies with the assessment of the peers which has been addressed in the requirements 5 and 6 for the Bachelor programmes.

With regard to requirement 1, it decides to maintain the original wording, thereby following the argument of the Technical Committee 02. The apparently different situation concerning the laboratory equipment for the Mechanical Engineering programmes should be considered explicitly in the respective requirement.

As to the internship, the Accreditation Commission agrees with the proposal of the Technical Committee 01 in changing a related requirement into a recommendation for the Bachelor's degree programmes in line with the other clusters dealing with LUT (see recommendation number E 2). In addition to that, it resumes a textual modification proposed by the Technical Committee 02 (changing "length" into "duration").

For the rest, the Accreditation Commission follows the assessment and recommended resolution of the peers and Technical Committees.

Assessment and analysis for the award of the EUR-ACE® Label:

The Accreditation Commission judges that the intended learning outcomes of the degree programmes do comply with the engineering specific part of Subject-Specific Criteria of the Technical Committees 01 and 02 respectively.

The Accreditation Commission for Degree Programmes decides to award the following seals:

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ba Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ba Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ma Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2023
Ma Mechatronic System Design	With requirements for one year	EUR-ACE®	30.09.2024
Ma Welded Metal Structures	With requirements for one year	EUR-ACE®	30.09.2024
Ma Sustainable Production in Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2024

Requirements

For all degree programmes

A 1. (ASIIN 4.3) A concept for upgrading the laboratories must be provided and initial steps for its implementation have to be undertaken or, with respect to the Mechanical Engineering programmes, a precise and meaningful account of the existing labs, including a prospect for their further development, has to be presented. Thereby, it must be demonstrated how the formation training in the laboratories is supportive to the intended educational goals and learning objectives.

A 2. (ASIIN 5.1) Rewrite the course descriptions so as to give a more precise idea of the contents.

A 3. (ASIIN 5.2) Include the more precise version of the programme-related learning outcomes – as set in the Self Assessment Report – into the respective Diploma Supplement. Provide also statistical data according to the ECTS user's guide in addition to the final grade in the Diploma Supplement.

A 4. (ASIIN 6) Provide a concept for a systemic monitoring of the study progress and its intended use for the development of the degree programmes. This should include meaningful cohort-wise statistical data concerning the graduation rate, the drop-out rate, the examination failure rate and the duration of study. Prove evidence that first steps of its implementation have been taken.

For the Bachelor's degree programmes

A 5. (ASIIN 1.3, 3) Develop and implement a process to systematically monitor the consistent alignment of intended learning outcomes and contents with the assessment of each course at the Bachelor's level.

A 6. (ASIIN 3) Ensure that “Final thesis instructions” with binding scientific standards for the Bachelor’s level are in place and followed in order to upgrade the quality of the Bachelor’s theses.

For the Master’s degree programmes in Mechanical Engineering

A 7. (ASIIN 2.2) Ensure a more balanced distribution of the students’ workload per semester concerning, in particular, the second study year.

Recommendations

For all degree programmes

E 1. (ASIIN 5.1) It is recommended to provide an adequate list of relevant literature references in the course descriptions.

For the Bachelor’s degree programmes

E 2. It is recommended to extend the duration of the compulsory internship and to demand a connection with the field of studies.

E 3. (ASIIN 4.1) It is recommended to take appropriate measures ensuring that fundamental and core courses of each programme are taught by experienced and well-qualified teaching personnel on a regular basis.

For the Master’s degree programme Electrical Engineering

E 4. (ASIIN 1.1) It is recommended to outline qualification profiles for the main fields of specialization or major module combinations and make them publicly accessible.

I Fulfilment of Requirements (29.06.2018)

Analysis of the peers and the Technical Committees (15.06.2018)

Requirements

For all degree programmes

A 1. (ASIIN 4.3) A concept for upgrading the laboratories must be provided and initial steps for its implementation have to be undertaken or, with respect to the Mechanical Engineering programmes, a precise and meaningful account of the existing labs, including a prospect for their further development, has to be presented. Thereby, it must be demonstrated how the formation training in the laboratories is supportive to the intended educational goals and learning objectives.

Initial Treatment	
Peers	fulfilled Vote: unanimously Justification: A concept for the upgrading of the Electrical Engineering laboratories has been provided which the peers consider to be convincing. In the same vein, the Mechanical Engineering laboratories are obviously quantitatively and qualitatively adequate to serve the learning objectives of the degree programmes under review.
TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.

A 2. (ASIIN 5.1) Rewrite the course descriptions so as to give a more precise idea of the contents.

Initial Treatment	
Peers	(already) fulfilled

	Vote: by the majority Justification: The form for updating the course information (attachment 14) seems competent. On the Oodi website, some course descriptions apparently do not have all information and / or contain vague information. Nevertheless, the peers consider the requirement essentially fulfilled.
TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.

A 3. (ASIIN 5.2) Include the more precise version of the programme-related learning outcomes – as set in the Self Assessment Report – into the respective Diploma Supplement. Provide also statistical data according to the ECTS user's guide in addition to the final grade in the Diploma Supplement.

Initial Treatment	
Peers	fulfilled Vote: unanimously Justification: The diploma supplements and learning outcomes have been enhanced and updated. The degree certifcates do contain the relevant information.
TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.

A 4. (ASIIN 6) Provide a concept for a systemic monitoring of the study progress and its intended use for the development of the degree programmes. This should include meaningful cohort-wise statistical data concerning the graduation rate, the drop-out rate, the examination failure rate and the duration of study. Prove evidence that first steps of its implementation have been taken.

Initial Treatment	
Peers	fulfilled Vote: unanimously Justification: Statistical material and proof of a systematic monitoring of the study progress of students has been provided.
TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.

For the Bachelor's degree programmes

A 5. (ASIIN 1.3, 3) Develop and implement a process to systematically monitor the consistent alignment of intended learning outcomes and contents with the assessment of each course at the Bachelor's level.

Initial Treatment	
Peers	fulfilled Vote: by the majority Justification: The university has established a mechanism to ensure and regularly check the alignment of intended learning outcomes, contents and assessment methods.
TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.

A 6. (ASIIN 3) Ensure that "Final thesis instructions" with binding scientific standards for the Bachelor's level are in place and followed in order to upgrade the quality of the Bachelor's theses.

Initial Treatment	
Peers	fulfilled Vote: unanimously Justification: University-wide instructions for the Bachelor thesis have been provided and are already available.

TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the peers.

For the Master's degree programmes in Mechanical Engineering

A 7. (ASIIN 2.2) Ensure a more balanced distribution of the students' workload per semester concerning, in particular, the second study year.

Initial Treatment	
Peers	fulfilled Vote: by the majority Justification: The majority of the peers considers the workload distribution in the Mechanical Engineering Master programmes reasonable now. However, one peer insists that the workload, at least in the second study year of the degree programmes Mechatronic System Design and Sustainable Production in Mechanical Engineering respectively, still seems very uneven (up to 35 to 36 ECTS points in the fourth semester).
TC 01	fulfilled Vote: by the majority Justification: The Technical Committee agrees with the assessment and proposed resolution of the majority of the peers.
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment and proposed resolution of the majority of the peers. In the case of the Master programmes in Mechanical Engineering, the Technical Committee takes note of a still somewhat uneven distribution of ECTS points in the Master programmes *Mechatronic Systems Design* and *Sustainable Production in Mechanical Engineering* (requirement 7). However, it concludes that this imbalance does not seriously impede the ability to study the course of the degree programmes.

Decision of the Accreditation Commission (29.06.2018)

The Accreditation Commission decides to prolong the award of the seals as follows:

Degree Programme	ASIIN-seal	Subject-specific label	duration of accreditation
Ba Electrical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2023
Ba Mechanical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2024
Ma Electrical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2023
Ma Mechatronic System Design	All requirements fulfilled	EUR-ACE®	30.09.2024
Ma Welded Metal Structures	All requirements fulfilled	EUR-ACE®	30.09.2024
Ma Sustainable Production in Mechanical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2024

J Assessment of Changes (20.09.2019): Ma Welded Metal Structures

As a planned change for the Academic Year 2019/2020, the university announces that the Master's degree programme “Welded Metal Structures” will be renamed “Advanced Structural Design and Robotised Welding”. Based on experience with student recruitment, the change is intended to inform students more precisely about the learning content. According to the university, the name change implicates minor adjustments to the study objectives. A few changes to the curriculum aim at an improved distribution of the student workload over the academic years and semesters and an alignment of the scope of the degree programme in the two focus areas (Steel Structures and Welding Processes). With the change notice, the university provides the renewed study objectives and curriculum as well as links to the module descriptions.

Analysis of the peers (02.09.2019)

Out of six peers involved in the accreditation procedure, four have commented on the change notice.

The peers unanimously agree that the planned name change of the degree programme, in conjunction with the changes to the curriculum, would constitute a significant change. However, they also agree that the award of the ASIIN seal and the EUR-ACE® label can be extended despite the amendments.

Analysis of the Technical Committee 01 – Mechanical and Process Engineering (05.09.2019)

The Technical Committee discusses the amendment and agrees with the vote of the peers.

The Technical Committee notes that the planned name change of the degree programme, in conjunction with changes to the curriculum, would constitute a significant change with regard to the accreditation. However, the Committee also acknowledges that the award of the ASIIN seal for the degree programme Ma Welded Metal Structures of the Lappeenranta-Lahti University of Technology, which is valid until 30 September 2024, can be extended despite the amendments.

In addition, the Technical Committee notes that the planned name change of the degree programme, in conjunction with changes to the curriculum, would constitute a significant change with regard to the accreditation. However, the Committee also acknowledges that the award of the EUR-ACE® label for the degree programme Ma Welded Metal Structures of the Lappeenranta-Lahti University of Technology, which is valid until 30 September 2024, can be extended despite the amendments.

Decision of the Accreditation Commission (20.09.2019)

The Accreditation Commission for Study Programmes notes that the planned name change of the degree programme, in conjunction with changes to the curriculum, constitutes a significant change with regard to the accreditation. However, the Commission decides to extend the award of the ASIIN seal for the degree programme Ma Welded Metal Structures of the Lappeenranta-Lahti University of Technology, which is valid until 30 September 2024, despite the amendments.

In addition, the Accreditation Commission for Study Programmes notes that the planned name change of the degree programme, in conjunction with changes to the curriculum, constitutes a significant change with regard to the accreditation. However, the Commission decides to extend the award of the EUR-ACE® label for the degree programme Ma Welded Metal Structures of the Lappeenranta-Lahti University of Technology, which is valid until 30 September 2024, despite the amendments.

Appendix: Programme Learning Outcomes and Curricula

According to SAR the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Bachelor's degree programme Electrical Engineering:

"1. Students will have basic skills in mathematics and science and be able to solve problems by applying suitable mathematical methods.

2. Students will be aware of the essential laws of physics and be able to apply them to various physical processes. Students will understand physical phenomena and be able to solve problems related to them. They will be able to carry out and report measurements.

3. Students will be able to name and describe the most essential applications and operating principles in electrical engineering and electronics.

4. Students will be able to describe the central instructions and regulations related to electrical safety, installations and electromagnetic compatibility.

5. Students will be able to use the most common measurement systems and perform calculations and measurements associated with electric circuits.

6. Students will be able to describe the operation and control principles of typical electrical machines and inverters.

7. Students will have generic employability skills; oral and writing skills in both their mother tongue and a foreign language, team work, time management, and information retrieval, social skills, and basic knowledge of entrepreneurship."

The following **curriculum** is presented:

1st Academic year Compulsory courses in BSc degree	1st period	ECTS	2nd period	ECTS	3rd period	ECTS	4th period	ECTS	Workload of studies in the first academic year
	BM20A4301 Introduction to Technical Computatio	1	BM20A4301 Introduction to Technical Computation	1	BM20A4301 Introduction to Technical Computatio	1	BM20A4301 Introduction to Technical Computatior	1	
	BM20A5800 Functions, Linear Algebra and Vectors	3	BM20A5810 Differential Calculus and Applications	4	BM20A5820 Integral Calculus and Applications	3	BM20A5830 Basic Course on Differential Equations	3	
	BM30A2600 Basics of Mechanics	4	BK10A4200 Product Design and Modeling	2	BM30A2900 Wave Motion and Wave Phenomena	3			
	BK10A4200 Product Design and Modeling	2	BH61A0000 Fundamentals of Energy Economics	2			BL30A0201 Laboratory Course in Electrical Enginee	5	
	BH50A0001 Introduction to Energy Technology	2	BL10A0000 Introduction to Studies in Electrical Engi	0,5	BK10A4200 Product Design and Modeling	1			
	BL10A0000 Introduction to Studies in Electrical Eng	0,5	BL10A0100 Basics of Electric Engineering	1,5	BL30A0000 Electric Circuits	2			
	BL10A0100 Basics of Electric Engineering	1,5	BL30A0000 Electric Circuits	2	BL30A0201 Laboratory Course in Electrical Enginee	0			
	BL30A0201 Laboratory Course in Electrical Enginee	0	BL30A0201 Laboratory Course in Electrical Engineer	0	BL50A0010 Basic Electronics A	2,5			
	BM30A0310 Physics, Laboratory Course (SÄTE)	3	BL50A0010 Basic Electronics A	2,5	FV13A0150 Swedish for students in technology *	2			
			BM30A0310 Physics, Laboratory Course (SÄTE)	3					
Compulsory studies, sum	*1 period*	17	*2 period*	18,5	*3 period*	14,5	*4 period*	9	59
Elective module in intermediate specialisation studies in electrical engineering: Electrical Power Systems with a minor in Industrial Engineering and Management					BH30A0001 Introduction to Nuclear Energy	1,5	BH30A0001 Introduction to Nuclear Energy	1,5	
All studies, sum	*1 period*	17	*2 period*	18,5	*3 period*	16	*4 period*	10,5	62

* Integrated in Product Design and Modeling

2nd Academic year Compulsory courses in BSc degree	1st period	ECTS	2nd period	ECTS	3rd period	ECTS	4th period	ECTS	Workload of studies in the second academic year
	BL30A0100 Electric Circuit Analysis	3	CT60A0201 Introduction to Programming	3	BM20A5840 Functions of Several Variables and Ser	1,5	BM20A5840 Functions of Several Variables and Seri	1,5	
	BL40A0110 Measurement and Automation Technology, Introduction	1,5	BH20A0700 Fundamentals of Engineering Thermodynamics	2	BM20A1501 Numerical Methods I	3	BL30A0300 Electromagnetism	3	
	BL50A0200 Introduction to EMC	2	BH60A0000 Basic Course in Environmental Technolo	1,5	BL30A0300 Electromagnetism	3	BL40A0200 Control Systems, Introduction	2	
	BH60A0000 Basic Course in Environmental Techno	1,5	BL40A0110 Measurement and Automation Technology, Introduction	1,5	BL40A0200 Control Systems, Introduction	2			
	CT60A0201 Introduction to Programming	3							
	FV18A2800 Finnish Spoken and Written Communication for Engineers**	1,5	FV18A2800 Finnish Spoken and Written Communication for Engineers**	1,5					
Compulsory studies, sum	*1 period*	12,5	*2 period*	9,5	*3 period*	9,5	*4 period*	6,5	38
Elective module in intermediate specialisation studies in electrical engineering: Electrical Power Systems with a minor in Industrial Engineering and Management			BH40A0301 Applied Thermodynamics	3	CS20A0002 Basic Course in Supply Chains and Ope	6	BH40A0101 Renewable Energy	3	
	CS10A0010 Basics of Marketing	3	CS10A0010 Basics of Marketing	3	CS30A0952 Innovation and Technology Manageme	3	CS30A0952 Innovation and Technology Manageme	3	
All studies, sum	*1 period*	15,5	*2 period*	15,5	*3 period*	18,5	*4 period*	12,5	62

** Can be taken also in periods 3-4 or 1st academic year

3rd Academic year Compulsory courses in BSc degree	1st period	ECTS	2nd period	ECTS	3rd period	ECTS	4th period	ECTS	Workload of studies in the third academic year
	BM20A1401 Statistics I	1,5	BM20A1401 Statistics I	1,5	CS31A0210 The Basic Course of Business Economic	3	BL10A3001 Electrical Safety	2,5	
	BL10A1002 Bachelor's Thesis Seminar	1	BL30A0500 Introduction to Electrical Drives	3	BL10A3001 Electrical Safety	2,5	BL10A1100 Bachelor's Thesis	2,5	
	BL10A1100 Bachelor's Thesis	2,5	BL10A1002 Bachelor's Thesis Seminar	0,5	BL10A1002 Bachelor's Thesis Seminar	0,5			
			BL10A1100 Bachelor's Thesis	2,5	BL10A1100 Bachelor's Thesis	2,5			
Compulsory studies, sum	*1 period*	5	*2 period*	7,5	*3 period*	8,5	*4 period*	5	26
Elective module in intermediate specialisation studies in electrical engineering: Electrical Power Systems with a minor in Industrial Engineering and Management	BL20A0700 Introduction to Electrical Power System	4	Language studies	2	BL40A2600 Wind power and solar energy technology and busines	2,5	BL40A2600 Wind power and solar energy technology and busines	2,5	
	CS31A0102 Basic Course in Cost Management	6			BH50A0200 Introduction to Power Plant Engineering	4	BL10A7000 Work internship in Bachelor's degree	2	
	Language studies	2			BH61A0200 Energy Economics	2	BH61A0200 Energy Economics	2	
							Language studies	2	
All studies, sum	*1 period*	17	*2 period*	9,5	*3 period*	17	*4 period*	13,5	57

According to SAR the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Electrical Engineering:

"After completing of the study programme the graduate will have acquired comprehensive knowledge in sustainable electricity systems and markets, and the specific knowledge and competencies necessary to have the expertise in the chosen area of specialisation.

The graduate will

- be able to demonstrate a comprehensive understanding of the important technologies, mechanisms, processes and practical applications, as well as of the scenarios and associated policy actions and economic implications concerning electricity production and use, power systems and renewable energy systems, electricity markets and trading
- have adopted the principles of life cycle thinking and sustainable development in the domain of energy and environment
- be able to demonstrate a critical understanding of relevant theories and techniques, problem solving skills, and ability to independently use knowledge, equipment and tools for the design and development of practical applications."

"The graduate will have the ability

- to logically think through a problem and solve it,
- to contribute to innovative thinking and
- to unambiguously communicate knowledge and solutions to the energy community and society, at large, in spoken and in written."

The following **curriculum** is presented:

	A	B	C	D	E	F	G	H	I	J
1										
2	**1st Academic year** Compulsory courses in MSc degree	**1st period**	op	**2nd period**	op	**3rd period**	op	**4th period**	op	**Workload of studies in the first academic year**
3		BL20A0900 Science, Technology and Society	4	BL30A1101 Laboratory Course in Electrical Power Engineering	2	BL40A2301 Energy Efficiency	6	BL30A1101 Laboratory Course in Electrical Power Engineering	4	
4		BL30A1101 Laboratory Course in Electrical Power Engineering	2					Language studies	2	
5										
6										
7										
8										
9										
10										
11	Compulsory studies, sum	*1 period*	6	*2 period*	2	*3 period*	6	*4 period*	6	20
12	Courses of elective specialisation modules Electricity Market, Electric Grids and Power Electronics	BL20A0400 Electricity Market	5	BL20A0500 Electricity Distribution Technology	4	BL20A0500 Electricity Distribution Technology	4			
13				BL20A0600 Electrical Power Transmission	5	BH60A4700 Climate Finance and Carbon Market	1,5	BH60A4700 Climate Finance and Carbon Markets	1,5	
14		BL30A0800 Electromagnetic Components		BL20A0201 Power Exchange Game for Electricit	1,5	BL20A0201 Power Exchange Game for Electricity	1,5			
15		BL30A0600 Power Electronics	3	BL30A0600 Power Electronics	3	BL20A0100 Thermal Design of an Electric Device	3			
16						BL30A0901 Power Electronic Components	2,5	BL30A0901 Power Electronic Components	2,5	
17	All studies, sum	*1 period*	14	*2 period*	15,5	*3 period*	18,5	*3 period*	10	58
18										
19										
20	**2nd Academic year** Compulsory courses in MSc degree	**1st period**	op	**2nd period**	op	**3rd period**	op	**4th period**	op	**Workload of studies in the second academic year**
21		BL10A8000 Work internship in Master's degree (2-10 ECTS)	2			BL10A2001 Master's Thesis	15	BL10A2001 Master's Thesis	15	
22		Language studies	2	BL30A1001 Electrical Drives	4	BL30A1001 Electrical Drives	4	BL10A8000 Work internship in Master's	2	
23										
24										
25										
26										
27										
28										
29	Compulsory studies, sum	*1 period*	4	*2 period*	4	*3 period*	19	*4 period*	17	44
30	Courses of elective specialisation modules Electricity Market, Electric Grids and Power Electronics	BL50A0600 Electromagnetic Compatibility in Power El	2	A250A0400 Microeconomics	6	BL20A1600 Smart Grids	2,5	BL20A1600 Smart Grids	2,5	
31						BL20A1001 Protection of Electricity Networks	5			
32										
33										
34										
35	All studies, sum	*1 period*	6	*2 period*	10	*3 period*	26,5	*4 period*	19,5	62

According to SAR the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Bachelor's degree programme Mechanical Engineering:

"After completing Bachelor's programme, students will be able to:

1. utilise mathematics and physics to solve problems of mechanical engineering and design

2. describe and define the physical and functional principles of different types of machines, manufacturing methods and production technologies and recognise their application areas

3. find information from different sources and to evaluate the reliability of that information and to utilise information to solve cross-disciplinary problems of engineering and business

4. recognise and understand different loading cases of machine parts and the strength properties of construction materials

5. form an overall picture of technical, economic, social and ethical viewpoints to solve engineering problems

6. carry out multi-disciplinary teamwork in a multi-cultural group of experts and use different means to reach the goals of international project work

7. convey the results of scientific research mutually and literally according to criteria given by the scientific community

8. utilise and apply the knowledge, skills and competences gained from their minor subjects to solve technical problems."

The following **curriculum** is presented:

	A	B	C	D	E	F	G	H	I	J
1										
2	**1. Academic year** Compulsory courses in BSc degree	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the first academic year**
3		BM20A5800 Funktiot, lineaarialgebra ja vektorit/F	3	BM20A5810 Differentiaalilaskenta ja sovellukset/Diffe	4	BM20A5820 Integraalilaskenta ja sovellukset/Inte	3	BM20A4301 Johdatus tekniseen laskentaan/Introduction t	4	
4		BM30A2600 Mekaniikan perusteet/Basics of Mech	4	BM30A2700 Lämpöopin perusteet/Basics of Thermal Ph	3	BM30A2900 Aaltoliikeoppi/Wave Motion and Wav	3	BM20A5830 Differentiaaliyhtälöiden peruskurssi/Basic Co	3	
5				CT60A0201 Ohjelmoinnin perusteet/Introduction to Pro	6	BK50A3400 Tekninen dokumentointi ja 3D-mallinn	5	BM30A3000 Sähköoppi/Electricity and Magnetism	4	
6						FV13A0150 Svenska för teknologer/Swedish for stu	2	BK80A2600 Mekaniikka/Mechanics	10	
7								BK10A0500 Johdatus konetekniikan opiskeluun/Introducti	1	
8										
9										
10										
11	Compulsory studies, sum	*1 period*	7	*2 period*	13	*3 period*	13	*4 period*	22	55
12	Elective / optional courses / exchange studies (ECTS)	Minor studies								
13										
14										
15										
16					4					4
17	All studies, sum	*1 period*	7	*2 period*	17	*3 period*	13	*4 period*	22	59
18										
19										
20	**2. Academic year** Compulsory courses in BSc degree	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the second academic year**
21				BK10A3500 Materiaalitekniikka/Materials	7	BL10A0100 Sähkötekniikan peruskurssi/Basics of E	3	BM20A5840 Usean muuttujan funktiot ja sarjat/Functions o	3	
22				BK60A0200 Mekatroniikka/Mechatronics	6			BK65A0203 Tekninen suunnittelu/Engineering Design	7	
23				FV18A2800 Tekniikan puhe- ja kirjoitusviestintä/Finnis	3			BK10A3600 Valmistus- ja tuotantotekniikka/Production Tec	12	
24								BK80A2700 Lujuusoppi/Strength of Materia	12	
25										
26										
27										
28										
29	Compulsory studies, sum	*1 period*	0	*2 period*	16	*3 period*	3	*4 period*	34	53
30	Elective / optional courses / exchange studies (ECTS)	Minor studies								
31		Language studies								
32		Elective studies								
33										
34					4				4	8
35	All studies, sum	*1 period*	0	*2 period*	20	*3 period*	3	*4 period*	38	61
36										
37										
38	**3. Academic year** **Compulsory courses in BSc degree**	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the third academic year**
39				BK30A1100 Laser Technology and 3D-printing	4	CS31A0210 Yritystalouden perusteet/The Basic Cou	3	BK10A0402 Kandidaatintyö/Bachelor's Thesis	10	
40				BK80A2202 Teräsrakenteet I/Design of Steel Structures	6			BK10A4300 Kandidaatintyöseminaari/Bachelor's thesis se	2	
41				BK80A2800 FE-analyysin sovellukset konetekniikassa/F	5			BK65A0900 Koneensuunnittelu/Machine Design	5	
42				BM20A1401 Tilastomatematiikka I/Statistics I	3			BK10A1300 Tekniikan kandidaatin tutkinnon työharjoittelu	2	
43										
44										
45										
46										
47	Compulsory studies, sum	*1 period*	0	*2 period*	18	*3 period*	3	*4 period*	19	40
48	Elective / optional courses / exchange studies (ECTS)	Minor studies								
49		Language studies								
50		Elective studies								
51										
52					10		8		2	20
53	All studies, sum	*1 period*	0	*2 period*	28	*3 period*	11	*4 period*	21	60

According to SAR the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Mechatronic System Design:

"By completing this Master's programme, students will acquire extensive knowledge of the design, hydraulics, control, dynamics and simulation of machines. Students will also learn about environmentally conscious design and the development of new technologies to solve current and future global problems. During the studies, students will be able to apply simulation tools to analyse demanding machine systems. This expertise can be applied to the most demanding research and development processes of the global industry.

Students will

1. be able to demonstrate a comprehensive understanding of the dynamics of mechatronic machines, simulation tools and their usage, and the multidisciplinary product development process.

2. have adopted the principles of applying theoretical methods to practice using virtual tools.

3. have the ability to design and implement control systems for mechatronic machines.

4. be able to work with others in task-orientated groups, participating and interacting in the group in a productive manner, and to lead and manage design projects

5. be able to think through industrial research and development problems logically and solve them, to contribute to innovative thinking

6. be able to understand the needs and special features of other disciplines beyond their core competence in mechanical engineering design."

The following **curriculum** is presented:

	1. Academic year	1. period	ECTS	2. period	ECTS	3. period	ECTS	4. period	ECTS	Workload of studies in the first academic year
3	Compulsory courses in MSc degree	FV11A9800 Academic Writing in English Course 1	2	BK10A1200 Research Methods and Methodologies	4	FV18A9101 Finnish 1*	2	BK50A2701 Selection Criteria of Structural Materials	5	
4				BK70A0001 Simulation of a Mechatronic Machine	5			BK10A4100 Management and Leadership Skills in Mechanical Engineering	5	
5				BK10A3800 Principles of Industrial Manufacturing Processes	5			FV11A9900 Academic Writing in English Course 2	2	
6				BK10A3900 Reliability Based Machine Element Design	5			BK60A0800 Fluid Power	5	
7				BK10A4000 Design of Advanced Plate and Shell Structures	5			BK70A0102 Simulation, Laboratory Course	5	
8				BK60A1001 Control of Mechatronic Machine	5			BK10A0300 Introduction to M.Sc. Studies*	1	
9										
10										
11	Compulsory studies, sum	*1 period*	2	*2 period*	29	*3 period*	2	*4 period*	23	56
12	Elective / optional courses / exchange studies (ECTS)	Minor studies								
13		Elective studies								
14										
15										
16					7				5	12
17	All studies, sum	*1 period*	2	*2 period*	36	*3 period*	2	*4 period*	28	68
18										
19										
20										
21	**2. Academic year**	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the second academic year**
22	Compulsory courses in MSc degree			BK70A0501 Machine Dynamics	5			BK10A1501 Master's Thesis and Seminar	30	
23				BK60A1500 Practical Laboratory Course in Motion Control and Mechatronics	5					
24										
25										
26										
27										
28										
29										
30	Compulsory studies, sum	*1 period*	0	*2 period*	10	*3 period*	0	*4 period*	30	40
31	Elective / optional courses / exchange studies (ECTS)	Minor studies								
32		Elective studies								
33										
34										
35					7				5	12
36	All studies, sum	*1 period*	0	*2 period*	17	*3 period*	0	*4 period*	35	52
37	Master's Degree, sum	120								

According to SAR the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Welded Metal Structures:

"In this Master's programme, students will learn about the design, analysis, fabrication and research of modern and competitive welded metal structures. Students will acquire a good understanding of the strength and ductility properties of metallic materials and their behaviour under long-term loading together with their weldability aspects. This will provide competencies to design different types of metal structures such as machine bodies, bridges, buildings, structural components and bodies for vehicles or supporting structures for different types of engineering applications.

After completing the Master's programme, students will

1. be able to demonstrate a comprehensive understanding of the design and fabrication of welded metal structures for demanding applications

2. have adopted principles of fatigue failure analysis of welded metal structures and metallurgical theories describing the behaviour of metallic materials due to different welding processes

3. have adopted the principles of innovative and critical thinking and purposeful problems solving

4. be able to work with others in task-orientated groups, participate and interact in the group in a productive manner, and lead and manage design projects

5. be able to think through theoretical and practical problems logically and solve them

6. be able to contribute to innovative thinking to improve the properties and lifetime expectations of welded metal structures."

The following **curriculum** is presented:

	1. period	ECTS	2. period	ECTS	3. period	ECTS	4. period	ECTS	Workload of studies in the first academic year
4	FV11A9800 Academic Writing in English Course 1	2	BK10A1200 Research Methods and Methodologies	4	FV18A9101 Finnish 1*	2	BK50A2701 Selection Criteria of Structural Materials	5	
5			BK70A0001 Simulation of a Mechatronic Machine	5			BK10A4100 Management and Leadership Skills in Mechanical Engineering	5	
6			BK10A3800 Principles of Industrial Manufacturing Processes	5			FV11A9900 Academic Writing in English Course 2	2	
7			BK10A3900 Reliability Based Machine Element Design	5			BK10A0300 Introduction to M.Sc. Studies*	1	
8			BK10A4000 Design of Advanced Plate and Shell Structures	5			*BK80A1402 Fatigue Design*		
9			*BK20A0403 Modern Welding Processes*				*BK20A2500 Sustainable Welding Production*		
10							*BK20A2400 Materials and Welding Metallurgy*		
11							*BK80A1301 FE-analysis, Advanced Course*		
12	*1 period*	2	*2 period*	24	*3 period*	2	*4 period*	13	41
13	Minor studies								
14	Elective studies								
15									
16									
17				7				5	12
18	*1 period*	2	*2 period*	31	*3 period*	2	*4 period*	18	53
19									
20									
21	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the second academic year**
22			BK80A3000 Integrated Design and Fabrication and Structures	5			BK10A1501 Master's Thesis and Seminar	30	
23			*BK20A2600 Modelling and Simulation in Welding*				BK80A3100 Scientific Research of Welding and Structures	5	
24							*BK80A2303 Steel Structures II*		
25									
26									
27									
28									
29									
30	*1 period*	0	*2 period*	5	*3 period*	0	*4 period*	35	40
31	Minor studies								
32	Elective studies								
33									
34									
35				7				5	12
36	*1 period*	0	*2 period*	12	*3 period*	0	*4 period*	40	52
37	105								
38	t least 15 ECTS cr								

According to SAR the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Sustainable Production in Mechanical Engineering:

"After completing the Master's programme, students will be ready to engage in modern, world-class manufacturing for a sustainable future. Students will learn to see the possibilities and restrictions of sustainable production. During the studies, students will develop skills enabling them to participate in demanding global development tasks of product and production design. They will be able to analyse challenging production tasks also by using simulation software.

Students will

1. be able to demonstrate a comprehensive understanding of manufacturing as a whole and an essential part of the company business

2. have adopted the principles of the most common and widely used manufacturing processes

3. be able to work with others in task-oriented groups, participating and interacting in the group in a productive manner, and to lead and manage individual production

4. be able to think through existing manufacturing problems in daily use logically and solve them, to contribute to innovative thinking

5. be able to understand possibilities of automation and robots for manufacturing stages."

The following **curriculum** is presented:

3	**1. Academic year**	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the first academic year**
4	Compulsory courses in MSc degree	FV11A9800 Academic Writing in English Course 1	2	BK10A1200 Research Methods and Methodologies	4	FV18A9101 Finnish 1*	2	BK50A2701 Selection Criteria of Structural Materials	5	
5				BK70A0001 Simulation of a Mechatronic Machine	5			BK10A4100 Management and Leadership Skills in Mechanical Engineering	5	
6				BK10A3800 Principles of Industrial Manufacturing Processes	5			FV11A9900 Academic Writing in English Course 2	2	
7				BK10A3900 Reliability Based Machine Element Design	5			BK10A0300 Introduction to M.Sc. Studies*	1	
8				BK10A4000 Design of Advanced Plate and Shell Structures	5			BK50A3600 Manufacturing Processes for Recyclable Products	5	
9				BK50A3500 Development of Sustainable Materials and Machinery for Packagir	5					
10										
11										
12	Compulsory studies, sum	*1 period*	2	*2 period*	29	*3 period*	2	*4 period*	18	51
13	Elective / optional courses / exchange studies (ECTS)	Minor studies								
14		Elective studies								
15										
16										
17					7				5	12
18	All studies, sum	*1 period*	2	*2 period*	36	*3 period*	2	*4 period*	23	63
19										
20										
21	**2. Academic year**	**1. period**	ECTS	**2. period**	ECTS	**3. period**	ECTS	**4. period**	ECTS	**Workload of studies in the second academic year**
22	Compulsory courses in MSc degree			BK50A3700 Productivity and Sustainability in Sheet Metal Production	5			BK10A1501 Master's Thesis and Seminar	30	
23								BK50A3900 Integration of Product's Design, Sustainable Production and Mater	5	
24								BK50A3800 Productivity and Sustainability of Metal Cutting	5	
25										
26										
27										
28										
29										
30	Compulsory studies, sum	*1 period*	0	*2 period*	5	*3 period*	0	*4 period*	40	45
31	Elective / optional courses / exchange studies (ECTS)	Minor studies								
32		Elective studies								
33										
34										
35					7				5	12
36	All studies, sum	*1 period*	0	*2 period*	12	*3 period*	0	*4 period*	45	57
37	Master's Degree, sum	120								