ASIIN Seal & EUR-ACE Label

Accreditation Report

Bachelor's Degree Programmes
Mechanical Engineering (Higher Professional Study Programme)
Mechanical Engineering (University Study Programme)

Master's Degree Programme
Mechanical Engineering

Provided by
University of Ljubljana, Faculty of Mechanical Engineering

Version: 06 December 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]
Visokošolski strokovni program prve stopnje STROJNIŠTVO – projektno aplikativni program	1st Cycle Higher Professional Study Programme in Mechanical Engineering – Project Oriented Applied Programme	ASIIN, EUR-ACE® Label	ASIIN, 2014-2018	TC 01
Univerzitetni študijski program prve stopnje STROJNIŠTVO – Razvojno raziskovalni program	1st Cycle University Study Programme in Mechanical Engineering – Research and Development Programme	ASIIN, EUR-ACE® Label	ASIIN, 2014-2018	TC 01
Magistrski študijski program druge stopnje STROJNIŠTVO – Razvojno raziskovalni program	2nd Cycle Master's Study Programme in Mechanical Engineering – Research and Development Programme	ASIIN, EUR-ACE® Label	ASIIN, 2014-2018	TC 01
Date of the contract: 05.12.2017 **Submission of the final version of the self-assessment report:** 29.01.2018 **Date of the onsite visit:** 10./11.01.2019 **at:** Faculty of Mechanical Engineering, Aškerčeva cesta 6, 1000 Ljubljana				
Peer panel: Prof. Dr.-Ing. Horst Baier, Technical University Munich Prof. Dr. rer. nat. Wolfgang H. Müller, Technical University Berlin Prof. Dr.-Ing. Hartmut Ulrich, Ruhr West University of Applied Sciences				

[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

Dr.-Ing. Matthias Wunderlich, Renault Group	
Representative of the ASIIN headquarter: Dr. Holger Korthals	
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 10.12.2015 Subject-Specific Criteria of Technical Committee 01 – Mechanical Engineering/Process Engineering 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
1st Cycle Higher Professional Study Programme in Mechanical Engineering	Diplomirani/-a inženir/-ka strojništva (VS) / Bachelor of Applied Science in Mechanical Engineering	• Power, Process and Environmental Engineering • Engineering Design, Machine Operation and Maintenance • Production Engineering • Mechatronics • Aviation	6	Full time, Part time	--	6 Semesters	180 ECTS	Once a year / Winter Semester 2009/2010
1st Cycle University Study Programme in Mechanical Engineering	Diplomirani/-a inženir/-ka strojništva (UN) / Bachelor of Science in Mechanical Engineering	--	6	Full time	--	6 Semesters	180 ECTS	Once a year / Winter Semester 2008/2009
2nd Cycle Master's Study Programme in Mechanical Engineering	Magister inženir / magistrica inženirka strojništva / Master of Science in Mechanical Engineering	• Machine Design and Mechanics • Power and Process Engineering • Production Engineering • Mechatronics and Laser Technology	7	Full time	--	4 Semesters	120 ECTS	Once a year / Winter Semester 2011/2012

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

For the Bachelor's degree programme Mechanical Engineering (Higher Professional Study Programme) the institution has presented the following profile in the Programme Information brochure (available on the Faculty website, https://www.fs.uni-lj.si/en/educational_process/first_degree_pap/program_information/, retrieved on 04.02.2019):

"Level 1 Higher Professional Study Programme Mechanical Engineering – Project Oriented Applied Programme is a 3-year programme, with study requirements amounting to 180 ECTS credits. [...]. Apart from the experience obtained on the practical training in industrial or research environment with the elaborated project and diploma work, a large part of the specific experience is acquired also in laboratory units in the regular teaching posts.

In line with the Bologna reform, the curriculum includes all elements that provide the student with adequate fundamental knowledge and broadness. With marked optionality, it allows profiling these skills according to the will and interests of an individual student. The programme includes accordingly a compulsory integrated part which is divided in Year 2 into five modules each covering specialised professional areas in mechanical engineering and aviation. Level 1 Higher Professional Study Programme Mechanical Engineering – Project Oriented Applied Programme consists of the following modules:

- POWER, PROCESS AND ENVIRONMENTAL ENGINEERING,
- ENGINEERING DESIGN, MACHINE OPERATION AND MAINTENANCE,
- PRODUCTION ENGINEERING,
- MECHATRONICS,
- AVIATION.

In Year 3 the programme is further divided into sub-modules. The number of sub-modules the individual module is divided to depends on specifics of the professional area. The existing programme modules are divided into sub-modules as follows:

- POWER, PROCESS AND ENVIRONMENTAL ENGINEERING:
    - Power Engineering,
    - Household and Sanitary Technology,
    - Process engineering.
- ENGINEERING DESIGN, MACHINE OPERATION AND MAINTENANCE:
    - Material Handling and Self-propelled Machines,
    - Vehicle Engineering,
    - Maintenance Management.
- PRODUCTION ENGINEERING:
    - Production Technologies,
    - Production Management,

    - Welding Technologies.
- MECHATRONICS:
    - Mechatronics.
- AVIATION:
    - Airplane Pilot/Helicopter Pilot,
    - Aircraft Design and Maintenance.

With exception of the Airplane Pilot/Helicopter Pilot sub-module, which is regulated by JAR FCL (Joint Aviation Requirements Flight Crew Licencing) of the European Joint Aviation Authority JAA, the curriculum for each module and sub-module is structured in the same way. Quality of the curriculum is demonstrated with a high degree of electiveness provided both by the required number of elective courses to be selected by the student in a certain stage of the study and by the number of courses given in the elective courses sets. Advice to students on choosing elective general courses is provided by their tutors."

For the Bachelor's degree programme Mechanical Engineering (University Study Programme) the institution has presented the following profile in the Programme Information brochure (available on the Faculty website, https://www.fs.uni-lj.si/en/educational_process/first_degree_rrp/program_information/, retrieved on 04.02.2019):

"With this programme, the goal is to provide a good educational basis for the areas of study, such as development of new products, production engineering, power engineering, environmental engineering, process engineering, new technologies and materials, mechatronics and road safety. […]

Needs of the economy and research institutions require fast and effective adjustments of higher education to modern science and technology trends as well as formation of specialists who will be able to become directly involved in the industrial work, science and research activities and development activities. Manufacturing and mechanical engineering contribute the largest part of Slovenia's exports. In order to achieve its goal, the Faculty has designed a study programme to educate development, evaluation, manufacturing and maintenance staff in the mechanical engineering area in its broadest sense. Particular emphasis will be on a rational use of materials, proper designing of building blocks, machines and apparatus, efficient use of energy and environmental acceptability.

Mechanical engineering is closely connected with other technical and industrial fields, such as electrical engineering, metallurgy, civil engineering, mining, traffic... […]

The main goal of the reformed Undergraduate University Study Programme Mechanical engineering – Research and Development Programme is to qualify the professional for solving efficiently and productively complex research and development problems and mechanical engineering tasks. […]

A graduate of the Level 1 University Study Programme Mechanical engineering – Research and Development Programme will become a professional with a comprehensive knowledge of mechanical engineering and will be employable in companies and institutions, involved in mechanical engineering in the broad sense. Currently, the demand for mechanical engineering graduates exceeds the supply of suitable specialists. With the acquired fundamental knowledge, the graduate will be able to successfully continue studying any Level 2 study programme in Slovenia or abroad, directly or indirectly related to mechanical engineering."

For the Master's degree programme Mechanical Engineering the institution has presented the following profile in the Programme Information brochure (available on the Faculty website, https://www.fs.uni-lj.si/en/educational_process/2nd_cycle__master_study_programme/master_study_programme_mechanical_engineering/program_information/, retrieved on 04.02.2019):

"The study programme is a continuation and upgrade of the revised programmes of the first level Mechanical Engineering studies, and a continuation and upgrade of the already covered professional content from the fields of mechanical design, power, process and environmental engineering, production engineering, production cybernetics and mechatronics. It is divided into several fields of study and specialisations, and consists of organised forms of study in the extent of 2500 hours or 100 ECTS, while the remaining 500 hours and 20 ECTS are intended for research work for the Master's thesis and its oral defence. […]

The basic objective of the Master's study programme of the second level Engineering – Development Research Programme is to further educate Bachelors of first level study programmes in the fields of engineering and natural sciences, enabling them to become professionals, able to efficiently and creatively solve complex problems of development research, as well as project tasks in the wider field of mechanical engineering, and connect on an interdisciplinary and synergetic level. To this end, the study programme is divided into a number of fields of study and interdisciplinary fields of study, according to the programmes' professional content.

The Master's degree Engineering - Development Research Programme is a two year programme, representing the second cycle of Bologna programme studies. It provides education in four basic fields of study and seven interdisciplinary fields.

The fields of study and specialisations are:

1. MACHINE DESIGN AND MECHANICS:
    - Mechanics of Materials, Systems and Processes
    - Engineering Design and Product Development
2. POWER AND PROCESS ENGINEERING
    - Thermal and Process Engineering
    - Power Engineering
3. PRODUCTION ENGINEERING:
    - Production Technologies and Systems
    - Design of Production Systems
4. MECHATRONICS AND LASER TECHNOLOGY

The interdisciplinary fields of study are:

1. TRAFFIC SAFETY SYSTEMS
2. ENGINEERING RHEOLOGY
3. ENVIRONMENTAL ENGINEERING
4. WELDING
5. TEROTECHNOLOGY,
6. ENGINEERING PEDAGOGY
7. ENGINEERING SAFETY“

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:

- Study Programme Information pages of the faculty website
    - 1st Cycle Higher Professional Study Programme in Mechanical Engineering: https://www.fs.uni-lj.si/en/educational_process/first_degree_pap/program_information/
    - 1st Cycle University Study Programme in Mechanical Engineering: https://www.fs.uni-lj.si/en/educational_process/first_degree_rrp/program_information/
    - 2nd Cycle Master's Study Programme in Mechanical Engineering: https://www.fs.uni-lj.si/en/educational_process/2nd_cycle__master_study_programme/master_study_programme_mechanical_engineering/program_information/
- Study Programme Presentation brochures (available on the above-mentioned pages of the faculty website) for all degree programmes
- Self-Assessment Report
- Discussions with representatives of faculty management, programme coordinators, students, lecturers and business representatives

Preliminary assessment and analysis of the peers:

The peers take note that the faculty presents extensive sets of objectives and learning outcomes for all degree programmes to be assessed in this accreditation procedure (cf. Appendix). For each programme, the learning outcomes are divided into “general competences” and “sub-

[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.

ject-specific competences". They are accessible to students, staff members and other stakeholders via links on the subject-specific pages of the faculty website to the Slovenian versions of the Study Programme Presentation brochure. However, while the English-language brochure for the Bachelor's programme Mechanical Engineering (University Study Programme) quotes those learning outcomes in translation, the webpages and the English versions of the brochures for the Bachelor's programme Mechanical Engineering (Higher Professional Study Programme) and the Master's programme Mechanical Engineering merely include short and generic descriptions of the objectives.

The peers recognise that, in formulating the desired learning outcomes for all degree programmes, the faculty has largely followed the EUR-ACE framework standards of engineering programmes and the Subject-Specific Criteria of the ASIIN Technical Committee for Mechanical Engineering and Process Engineering. Accordingly, the study aims and learning outcomes of the Bachelor's programmes correspond to level 6 of the European Qualifications Framework while that of the Master's programme correspond to level 7. The distinction between the two Bachelor's programmes complies with the distinction made in the ASIIN Subject-Specific Criteria between more practice-oriented and more research-oriented programmes. The representatives of the faculty management inform the peers about the historical origins of the programmes: Before the implementation of the Bologna system, one of the programmes was a two-year programme designed like at a university of applied sciences, the other one a four-year university Diploma programme. The faculty adjusted the programmes to the Bologna requirements by extending the applied programme to three years and splitting the academic programme into a Bachelor's and a Master's programme. This is obviously one of the reasons why an overwhelming majority of graduates from the University Study Bachelor's programme still continues their studies by enrolling in the Master's programme instead of entering the labour market with the Bachelor's degree.

In the respective discussions, both students and business representatives confirm the position of the faculty that there is a high demand on the labour market for graduates from the Master's programme and the Higher Professional Study Bachelor's programme. The companies prefer graduates from the Master's programme but also employ those with a Bachelor's degree from the Higher Professional Study Programme – the first group for tasks in the R&D sections, the second mainly for production. Sometimes, students of the Master's programme already have an employment and are trained on the job in the last phase of their studies, while in other cases the companies attract the students with scholarships. The business representatives attest the programmes a good balance between mechanical, electrical and software aspects of engineering and appreciate the orientation towards project-based learning. They also state that the possibility to include subjects from the Faculty of Electrical Engineering should be even extended in the future.

Judging from the close connection between the faculty and the industrial partners displayed in the discussion panel, it is also credible that, like the faculty states in the Self-Assessment Report, the industrial companies are regarded as the most important external stakeholders and that they are therefore involved in the quality assurance process for the study programmes by collecting their feedback and recommendations.

In summary, the peers gain the impression that the objectives and intended learning outcomes meet the requirements of the Subject-Specific Criteria of the ASIIN Technical Committee for Mechanical Engineering and Process Engineering and of the EUR-ACE framework. They consider the defined learning outcomes to reflect the level of academic qualification aimed at and to be viable and valid. The qualification profiles of the study programmes allow the students to take up occupations that correspond to their qualifications. Concerning the quality assurance and the further development of the programmes, the peers approve that the faculty has set up several committees with teaching staff and student participation (Committee for 1st Cycle Studies, Committee for 2nd Cycle Studies, and Committee for Quality Assurance) which regularly monitor the performance of the programmes and develop improvement proposals for the faculty senate.

Criterion 1.2 Name of the degree programme

Evidence:

- Higher Education Act of the Republic of Slovenia
- Study Programme Presentation brochures for all degree programmes
- Self-Assessment Report
- Discussions with representatives of faculty management and programme coordinators

Preliminary assessment and analysis of the peers:

The names of all degree programmes are published on the subject-specific pages of the faculty website as well as in the Study Programme Presentation brochures (available as PDF). Based upon the analysis of the different sets of learning outcomes, the peers acknowledge that the names reflect the intended aims and learning outcomes. This applies particularly to the Bachelor's programme Mechanical Engineering (University Study Programme) with its extensive approach to cover all relevant fields of Mechanical Engineering. Largely, it also applies to the Bachelor's programme Mechanical Engineering (Higher Professional Study Programme) and the Master Programme Mechanical Engineering, despite the fact that those degree programmes offer students a number of pathways and the opportunity to attain high levels of specialisation within the range of Mechanical Engineering.

Concerning the use of language in the courses, the peers learn from the representatives of the faculty management that the language policy of the Slovenian government is relatively strict with regard to the acceptance of teaching in foreign languages. The Higher Education Act of the Republic of Slovenia stipulates that the language of instruction shall be Slovenian and that Higher Educational Institutions shall ensure the development of Slovenian as a professional and scientific language. The faculty would like to increase the number of courses only taught in English but the law leaves only few exceptions, which do not apply to the programmes. Consequently, they have to provide the same courses in Slovenian for the Slovenian students and in English for the international students; both groups only merge during practical exercises. The peers consider this an obstacle for the internationalisation of the programmes that, however, can only be dealt with on a political level beyond the responsibilities of the university.

Criterion 1.3 Curriculum

Evidence:

- Study Programme Presentation brochures for all degree programmes
- Curricular overviews for all degree programmes
- Course descriptions for all degree programmes
- Self-Assessment Report
- Discussions with representatives of faculty management, programme coordinators, students and lecturers

Preliminary assessment and analysis of the peers:

From the statements made in the Self-Assessment Report and the discussions with the faculty representatives and students, the peers gain the overall impression that the curricula of all degree programmes represent well-established sets of fundamental engineering knowledge and specialised knowledge in different fields of mechanical engineering. They also recognise that the faculty has established structures (like the Committees for the 1st and 2nd Cycle Studies) and processes to evaluate, update and gradually improve the curricula.

Based on such evaluations and after discussion in the relevant bodies, the faculty implemented some changes and improvements since the previous accreditation. In the Bachelor's programme Mechanical Engineering (Higher Professional Study Programme), it removed an anomaly in the distribution of ECTS credits over the semesters that had affected the specialisation area "Aviation" since its inclusion into the programme. In the Bachelor's programme Mechanical Engineering (University Study Programme), it met a requirement

from the accreditation procedure and added a final thesis to the 6th semester of the programme. As for the Master's programme, the student evaluation surveys showed dissatisfaction with an unequal distribution of the workloads and ECTS credits in a number of modules/courses of the different specialisations. In order to solve this problem, the workloads and credits for the modules/courses of the areas of specialisation have been harmonised. The modules/courses are now uniformly awarded with 5 ECTS credits, and the course syllabi have likewise been restructured to match credits and student workloads.

The peers learn that the faculty is in the process of analysing how to improve the teaching content and the curricula further, since the teaching staff is undergoing a transformation (cf. Chapter 4.1) and the younger staff members have new suggestions.

One aspect of the programme that astonishes the peers are the many areas of specialisation and sub-specialisation (termed "modules" and "sub-modules" by the faculty, which does not comply with the common use of those terms, cf. Chapter 2.1) in the Higher Professional Study Bachelor's programme and, most notably, in the Master's programme. Particularly the interdisciplinary fields of specialisation draw their attention because, as the faculty admits, there is no sufficient demand to run them, and even in the past only two of them (Automotive and Welding) were running for a limited time. While the peers think that this could be an impetus to reflect upon the necessity of certain specialisations and the advantages of focussing on a smaller number, the faculty argues that it does not do harm to keep them although there is currently and foreseeably no demand. The peers take note that the established fields of specialisation and the respective elective courses experience an unequal distribution of student demand either. While the demand for Production Engineering is high, the groups are smaller in Mechatronics and Industrial Engineering. Formally, a minimum number of 15 students is required for running a course but the lecturers also conduct elective courses with five participants – although they do not receive full payment for the course in this case.

The peers agree that the curriculum allows the students to achieve the intended learning outcomes, and they recognise that the course descriptions clearly inform the students which knowledge, skills and competences they will acquire in each module/course. However, they doubt that the overall objectives and intended learning outcomes for the degree programme have been systematically connected with and substantiated in the modules/courses. They miss information about how the faculty links the specific learning outcomes on programme level with the outcomes on module/course level, and which courses focus on which skills and competences in particular. The peers recommend that the faculty defines and documents the connection between the learning outcomes on programme level and on module/course level before the next reaccreditation procedure – by using an objectives-modules-matrix or in another appropriate way. Furthermore, the faculty should

also re-evaluate the learning outcomes on programme level with particular regard to the EUR-ACE criteria for outcomes of Bachelor's and Master's programmes.

With regard to transferable or soft skills, the peers are not convinced that the catalogue of "general competences" as part of the intended learning outcomes is adequately met by the curricula. The peers thus reckon that the representation of transferable skills in the curricula should be strengthened.

Finally, the peers and the representatives of the faculty management discuss about how to handle the interdisciplinary specialisation "Engineering Pedagogy" of the Master's programme. In the previous period of accreditation, that area of specialisation was excluded from the accreditation since the title students would obtain upon graduation is a "Master of Education". In retrospect, the decision was questioned by the European Network for Accreditation of Engineering Education (ENAEE) which has authorised ASIIN to award the EUR-ACE label. The ENAEE disfavoured the exclusion of parts of a study programme from the EUR-ACE label and defined that programmes should either be awarded with the label as a whole or that the label should be refused. Therefore, the peers support the award of the EUR-ACE label for the Master's programme without exclusions but require from the faculty that they will immediately inform ASIIN if there is student demand to activate that area of specialisation.

Criterion 1.4 Admission requirements

Evidence:

- Study Programme Information pages of the faculty website
    - 1st Cycle Higher Professional Study Programme in Mechanical Engineering: https://www.fs.uni-lj.si/en/educational_process/first_degree_pap/program_information/
    - 1st Cycle University Study Programme in Mechanical Engineering: https://www.fs.uni-lj.si/en/educational_process/first_degree_rrp/program_information/
    - 2nd Cycle Master's Study Programme in Mechanical Engineering: https://www.fs.uni-lj.si/en/educational_process/2nd_cycle__master_study_programme/master_study_programme_mechanical_engineering/program_information/
- Study Programme Presentation brochures (available on the above-mentioned pages of the faculty website) for all degree programmes
- Self-Assessment Report

- Faculty Presentation (PowerPoint) with facts and figures
- Discussions with representatives of faculty management, programme coordinators, students and lecturers

Preliminary assessment and analysis of the peers:
As the faculty states in its Self-Assessment Report, admission to all degree programmes is limited. Currently, they admit 220 full-time and 60 part-time students to the Higher Professional Study Bachelor's programme, 200 students to the University Study Bachelor's programme and 220 students to the Master's programme. In recent years, the faculty has followed a strategy to downsize the number of students deliberately and reduced the admission numbers in order to guarantee success of the students in an internationally reputable programme. "Enrollment of even better students" is one of the key objectives in the faculty's strategy for 2019-2025, as outlined in the Faculty Presentation shown to the peers.

A chart with the numbers of the students enrolled in all programmes of the faculty demonstrates the decrease between the academic years 2014/2015 and 2018/2019, which particularly applies to the Bachelor's programmes. Before the reduction of admission numbers, many students were enrolled mainly because of a number of financial privileges that the student status offers in Slovenia but were not actually studying. The number of applicants still exceeds the admission numbers (e.g. 300-400 for the Higher Professional Study Bachelor's programme) but is also decreasing because the potential applicants see in advance that they will not meet the requirements.

The overwhelming majority of students who have been admitted to the Master programme have graduated from the Bachelor's programmes of the faculty. In 2017, the share of students with a degree from other faculties or universities reached about 15 %, in 2018 it was remarkably smaller. Among this small group, the number of students who studied other disciplines at the University of Ljubljana outweighs the number of students coming from other universities. The number of incoming students from other European countries within the Erasmus+ exchange has recently increased from about 25 in 2015 to 62 in 2018. As they all are on the Master level, the faculty created a mixed offer of courses held in English with contributions from the different fields of specialisation.

The peers acknowledge that the admission requirements and selection criteria are transparently displayed on the subject-specific pages of the faculty website. The rules and procedures are binding and the same for all applicants. The admission requirements are structured in a way that supports the students in achieving the learning outcomes. Since the faculty pursues a strict admission policy and does not offer any exceptions to the admission requirements, rules for the compensation of missing competences have not been developed. However, if students of the Higher Professional Study Bachelor's programme want

to switch to the University Study Bachelor's programme or enroll in the Master's programme after graduation they can take some additional courses in their third study year and thus complete the necessary study obligations before the application

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

In its reply to the preliminary report, the faculty expresses its willingness to follow the peers' suggestions and to review the connection between the learning outcomes on programme level and on module/course level during the process of programme adaptation which has been started recently (cf- Chapter 1.3). According to the faculty, they will also include the re-evaluation of the learning outcomes on programme level with regard to the EUR-ACE criteria for outcomes of Bachelor's and Master's programmes and address the issue of the representation of transferable skills in the curriculum in that adaptation and improvement process.

The peers appreciate the commitment of the faculty. With regard to the fact that the above-mentioned adaptation process is a medium-term project that will not result in immediate measures, they maintain their recommendations.

2. The degree programme: structures, methods and implementation

Criterion 2.1 Structure and modules

Evidence:

- Study Programme Presentation brochures for all degree programmes
- Curricular overviews for all degree programmes
- Course descriptions for all degree programmes
- Tables of transition figures between study years
- Rules on international exchange in scope of the Erasmus program (only provided in Slovenian) and Faculty Presentation (PowerPoint) with facts and figures
- Self-Assessment Report
- Discussions with programme coordinators, students and lecturers

Preliminary assessment and analysis of the peers:

As mentioned briefly in Chapter 1.3, the way the faculty makes use of the term "module" differs remarkably from what is outlined as a module in the ASIIN General Criteria, where a module is

defined as “a sum of teaching and learning whose contents are concerted.” This, as well as the alternative use of the terms “module” and “course unit” in the EUR-ACE Framework Standards and Guidelines points to the fact that the “courses” of all degree programmes can be identified with modules, particularly since most of them consist of different parts like lectures and exercises, and most of them also form units for which 5 or more ECTS credits are awarded. What the faculty calls a “module” or “sub-module” is evidently a larger unit that is composed of a number of modules/courses and would better consistently be called area or field of specialisation. Where the term “module” is used in this report, it will therefore be a synonym for “course” and should not be misunderstood as a reference to the areas of specialisation.

The faculty has developed a classification of modules/courses and defined four types:

- Compulsory General Courses (CGC), which include fundamental mathematics, physics, mathematical and numerical modelling knowledge;
- Compulsory Specialised Courses (CSC), which provide students with fundamental mechanical engineering knowledge; the practical training and the final thesis are classified as CSC either;
- Elective Specialised Courses (ESC), which allow students to acquire detailed knowledge from the specialised areas of the study programme;
- Elective General Courses (EGC), which include topics from other study programmes, picked up by students according to their preferences.

The distribution of the four types of courses is different for each of the three degree programmes. The share of Compulsory General Courses is the highest in the University Study Bachelor’s programme where it amounts to 23.8 % (in contrast to 15 % in the Higher Professional Study Bachelor’s programme and 12.5 % in the Master’s programme) while the share of Compulsory Specialised Courses is far more dominant in the Higher Professional Study Bachelor’s programme with 68.3 % than in the other programmes (51.6 % in the University Study Bachelor’s programme, 52.5 % in the Master’s programme. Expectedly, the share of elective courses of both types is higher in the Master’s programme than in the Bachelor’s programmes – 35 % in comparison with 24.4 % in the University Study Bachelor’s programme and 16.6 % in the Higher Professional Bachelor’s programme. However, it has to be regarded that the Compulsory Specialised Courses are compulsory within the chosen area of specialisation; students thus have the possibility to create highly individualised curricula for themselves while only the small share of Compulsory General Courses (12.5 %) frames the different specialisations. The distribution of the course types over the respective programmes reflects very well the distinctions between them. The peers agree that, with its choice of modules, the structures ensure that the learning outcomes can be reached and allow students to define an individual focus and course of study.

Practical training plays an important role in the Higher Professional Study Bachelor's programme and in the Master's programme. In the Bachelor's programme it is part of the 6th semester as a one-month practical work, performed in an industrial or research environment. According to the programme coordinators, about 80 % of the students choose an industrial company. The practical training is monitored and professionally guided by corresponding mentors at the faculty and in the industrial company and finished by a realised project work. It is formalised as a tripartite agreement signed by the person responsible at the faculty, the representative of the company or organisation where the training takes place, and the student. In the Master's programme, the practical training is part of the 4th semester. It is designed as an intensive individual or team research work at the faculty laboratory (or several other laboratories) or at a development department of a business enterprise, and it serves as a preparation for the Master's thesis. Reflecting its character as a more theory-oriented programme to be continued with the Master's programme, the University Study Bachelor's programme does not include compulsory practical training. Nevertheless, students can opt for professional training in the form of a 3-week guided practical work in an industrial or research environment, resulting in a project work and awarded with 5 ECTS credits. The peers reckon that the working practice intervals are well-integrated into the curriculum, and that the faculty has set up structures and processes in order to guarantee their quality in terms of relevance, content and structure.

In the Self-Assessment Report, the faculty commits itself to the support of student mobility. The acknowledgement of executed study obligations at a foreign institution is regulated by "Rules on international exchange in scope of the Erasmus program" that can also apply to mobility within other exchange programmes. The recognition depends on an examination of study programmes and curricula of the foreign institution. So far, the faculty has recognised seven partner universities as particularly adequate and recommends them to its students. Counselling is provided by the Erasmus coordinator of the faculty. The faculty has not defined a "mobility window" but considers the final semesters of the Bachelor's programmes and the whole course of the Master's programme suitable. In the discussion with the students, the peers find out that the most common choice for a stay abroad is the first year of the Master's programme. From the students' perspective, the acknowledgement of achievements at the partner universities works well. The number of outgoing students within the Erasmus+ exchange programme per year has recently increased from about 30 (2015-2017) to about 45 (2017-2019).

Apart from the recognition of courses attended at another university within a foreign exchange programme, the faculty has also developed processes for the recognition of students' knowledge attained before the enrollment in one of the degree programmes. Upon request by application, either the Committee for 1st Cycle Studies or the Committee for 2nd

Cycle Studies will check the certificates or other documents of the applying student and, if the decision is in favour, recognise the knowledge and skills as a replacement for certain courses and assign the respective credit points.

Concerning the progression of the students and the number of graduates, the peers learn that the statistical data kept by the faculty document a high number of drop-outs, especially in the first semesters of the Bachelor's programmes. While the reduced admission numbers seem to show a positive effect in the University Study Bachelor's programme (where the percentage of students who advance to the second year without delay has risen from 52 to 71 during the last five years), the trend is less favourable for the Higher Professional Bachelor's programme (where the transition rate still remains around 40 %). The faculty mainly blames the shortcomings of high school education for those results but has also taken measures in reaction. It has instituted introductory courses of secondary school mathematics, technical documentation and descriptive geometry that take place before the regular study process, and it provides more demonstrators and student tutors for additional support during that study process.

In the discussion with the peers, the students confirm that the number of drop-outs has decreased since the faculty has started admitting less students. However, particularly in the Master's programme, students often prolong their studies by making use of the "graduation year", which allows them to extend their study time for one year either in a bachelor's or in a master's programme. The "graduation year" can be used as a flexible buffer, e.g. to make up for lost time if someone missed a semester because of sickness or to fulfil the extra mathematics requirements if someone wants to get admitted to the Master's programme after graduation in the Higher Professional Study Bachelor's programme.

Although they advise the faculty to monitor further whether the reduced admission numbers and the additional introductory courses actually result in improved transition rates in all degree programmes in the medium term, the peers concede that the curricula are structured in a way that allows students to complete the degree without exceeding the regular course duration.

Criterion 2.2 Work load and credits

Evidence:

- Curricular overviews for all degree programmes
- Course descriptions for all degree programmes
- Self-Assessment Report
- Discussions with programme coordinators, students and lecturers

Preliminary assessment and analysis of the peers:
The faculty makes use of the ECTS credit point system and allocates ECTS credits to the modules/courses according to an estimated workload that is required from an average student for the successful completion of the course. The workload comprises both attendance-based learning and self-study. The course descriptions inform about how the workload is divided into the time spent on contact lessons (lectures, seminars, tutorials, etc.) and the time for individual work. All mandatory parts of the degree programmes, including practical training, Bachelor's and Master's thesis, are awarded with credits.

The allocation of credits is based on the assumption that one ECTS credit consistently equals a workload of 25 hours. In all degree programmes, the ECTS credits are evenly distributed over the semesters; so that in every semester students can acquire a total of 30 credits. The faculty affirms that peaks in the workload are avoided by its uniform distribution and the coordination of examination activities during the semester (colloquia, exercise reports, homework, etc.) and at the end of the semester (exams) by the study-year coordinator. The student evaluation survey includes questions that check the agreement between the nominal workload according to the course descriptions and the actual workload.

In the discussion with the students, the peers learn that they largely share the opinion of the faculty that the estimated time budgets are realistic and that no significant discrepancies occur between actual workload and ECTS credits. According to them, the recent changes in the teaching staff have had a positive effect in the way that the younger professors try to comply with the workload-credits ratio while in the past some courses taught by older professors had shown discrepancies. However, a majority of the students thinks that the relatively small number of credits for the final thesis in the University Study Bachelor's programme does not match the actual workload. Of the programme coordinators with whom the peers discuss that subject either, one is in favour of awarding the final thesis with more credits while another argues that the results of the small thesis are of high quality and that the requirement of a larger work would cost the students more time and possibly prolong the transition to the Master's programme.

The peers conclude that the workload has been calculated realistically for the modules/courses of all degree programmes, with the exception of the final thesis in the University Study Bachelor's programme. From their perspective, the faculty is required to ensure that the credits awarded for that Bachelor's thesis correspond with the actual student workload.

Criterion 2.3 Teaching methodology

Evidence:

- Course descriptions for all degree programmes
- Self-Assessment Report

- Discussions with programme coordinators, students and lecturers.

Preliminary assessment and analysis of the peers:
In the Self-Assessment Report, the faculty states that teaching in all degree programmes is mainly based on lectures, which are held by those lecturers who achieved the status of "habilitation" (cf. Chapter 4.1), exercises in groups of different size (auditorial exercises with up to 30 students, large group laboratory exercises with up to 18 students and small group laboratory exercises with up to 9 students), seminars and other kinds of work like the practical training.

The peers are surprised about the information that, while it is not obligatory to attend the lectures, presence in the exercises has to reach at least 80 % for successful completion of the course. From the discussion with the students, they learn that this may become a liability in case of sickness since the Student Office keeps records of students' attendance with the help of an electronic tracking system and applies that rule quite strictly. If the attendance is less than 80 %, for whatever reason, there are not many possibilities for the lecturer to make a student pass that course.

In general, the students appreciate the quality of teaching and the didactic methods used by the lecturers. They confirm that the recent and ongoing replacement of older professors who have reached the retirement age by a younger generation of lecturers has an impact both on the teaching methods and on the (enhanced) supportive use of information technology. However, they also make suggestions for improvements: From their perspective, the professors could interact more concerning the conception of the courses in order to reduce overlaps between them and to link the theory lectures a bit more with everyday problems for better understanding. They also wish for more opportunities to process tasks in teamwork and for more field trips.

The discussion panel with the lecturers makes the peers recognise that particularly the younger professors, assistant professors and teaching assistants demonstrate a lot of devotion to academic teaching, including the use of new didactic methods and technical equipment. In conclusion, the peers find that the teaching methods and instruments in use support the students in achieving the learning outcomes. To them, the programmes seem to be well-balanced between attendance-based learning and self-study, and there is evidence that the University Study Bachelor's programme and, notably, the Master's programme offer students the opportunity to develop skills in academic research and writing. However, based on their impressions they agree with the students that the share of group work within the study programmes should be augmented with regard to the requirements of their future working environment.

Criterion 2.4 Support and assistance

Evidence:

- Regulations for the tutor system at the faculty (provided only in Slovenian)
- Student survey forms for 1st and 2nd cycle degree programmes
- Self-Assessment Report
- Discussions with programme coordinators, students and lecturers

Preliminary assessment and analysis of the peers:

According to the faculty, there are numerous offers providing services and information about the study programs and the execution of the study process by phone and electronically through the faculty website. Personal consultation for students is mainly available at the Student Office but also at the University Career Centre and the Office for International Cooperation, Scientific and Development Activity.

For the accompaniment of the teaching process, the faculty has established a system of mentoring and tutoring. Mentors are selected among the teaching staff, one for each study year of the three degree programmes respectively. The tutoring system is defined in corresponding written regulations. Apart from tutoring by members of the teaching staff, student tutorship is also available. In the opinion of the faculty, it is especially the student-provided tutoring that contributes to a better performance of students who are experiencing learning difficulties. The student evaluation survey contains a section dealing with the general performance of the faculty and includes questions on the provision of information at the faculty and on counselling.

The students confirm that they are satisfied with the system of mentoring and tutoring, and that addressing a fellow student tutor is usually their first choice, while addressing a teaching assistant is the second. When it comes to choosing their respective fields of specialisation, they feel adequately counselled either. Both for the Higher Professional Study Bachelor's programme and the Master's programme the faculty and the Student Council jointly arrange a two-day period in which all the chairs and their laboratories present their topics.

As the faculty pursues a policy to provide equal opportunities to students with special needs and with disabilities, it offers possibilities for adjustments to enable such students to enroll in its study programmes. The adjustment measures cover the organisation of exams (extended time, breaks, conducting of oral exams in written form or vice versa), the laboratory work (special space and access to machines, individual approach, contextual adjustments), and the relaxation of deadlines for the execution of compulsory assignments, seminar papers, and other study obligations.

The peers thus acknowledge that sufficient resources are available to provide individual assistance, advice and support for all students, and that the allocated advice and guidance assist the students in achieving the learning outcomes and in completing the courses within the scheduled time.

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

With regard to criterion 2, the faculty agrees with the peers' comments on the use of the term "module" and intends to follow their proposals during the process of the programme adaptation (cf. Chapter 1.3). Concerning a change in the number of ECTS points for the Bachelor's thesis in the University Study Bachelor's programme, the faculty argues that it would be a major programme change that needs approval not only by the university but also by the national accreditation agency. They ask the peers to consider that, for this reason, the implementation of such a change will probably take at least two or three years.

The peers understand the concerns of the faculty about the fulfilment of a requirement to adapt the student workload of the Bachelor's thesis in the University Study Bachelor's programme to the ECTS credits awarded for it. However, they point out that raising the number of ECTS points is not the only option for dealing with this issue. The faculty could as well demonstrate by a workload analysis that the student workload is not higher than that of a regular module/course, or reduce the requirements if the workload turns out to be inadequately high. Therefore, they maintain their decision to suggest a requirement.

3. Exams: System, concept and organisation

Criterion 3 Exams: System, concept and organisation

Evidence:

- Study Rules of the faculty (provided only in Slovenian)
- Examination and Assessment Rules of the faculty (provided only in Slovenian)
- Rules about the preparation and presentation of final theses for all degree programmes (provided only in Slovenian)
- Selection of examination papers and final theses
- Self-Assessment Report
- Discussions with representatives of faculty management, programme coordinators, students and lecturers

Preliminary assessment and analysis of the peers:
The peers recognise that the faculty has defined a form of assessment for each of the modules/courses that are offered within the curricula of the three degree programmes. Binding rules for the organisation of exams and grading, including for the Bachelor's and the Master's thesis, are laid down in several regulation documents like the "Study Rules", the "Examination and Assessment Rules" and the "Rules about the preparation and presentation of final theses".

According to the faculty, there are at least five examination terms for each course in all degree programmes. Two examination terms are at the end of the winter semester, in the period between the middle of January and the middle of February, two examination terms are in June at the end of the summer semester and at least one examination term is between the middle of August and the middle of September. Within one period, the examination terms are generally two weeks apart. The course examination terms as well as the colloquia terms are defined with the help of student's representatives to avoid unnecessary peaks of study loads. Nevertheless, in the discussion with the students the peers encounter at least one critical remark about the exam schedule being too crowded in January.

The colloquia are a kind of (usually written) mid-term assessment that the faculty sees as an option for the students to check their knowledge at an intermediate stage of the course. In some courses, the success at the colloquia will be considered when grading the knowledge at the course examination stage. While the students have positive opinions about the colloquia, they are less content with courses in which the assessment is done by a number of short reports throughout the semester. While the lecturers who use that method of assessment argue that the students are better prepared in the lectures and exercises, and the learning progress can be monitored better some students suggest reducing the number of reports in order to have more time for studying.

Altogether, students have five opportunities to pass the exam for a specific course. They can take one re-examination 14 days after the initial one, the next one half a year later. At the fourth and fifth repetition of the exam an oral examination, which is supervised by a commission of three teachers, is obligatory. For the fifth repetition, the commission has to be approved by the faculty senate. Students with special needs and students with disabilities are guaranteed adjustments in conducting the exams (cf. Chapter 2.4).

While most of the exams are conducted in written form, especially in the first semesters of the Bachelor's programmes, there is some variety in higher semesters and in the Master's programme for which the programme coordinators claim an increased number of oral exams and presentations. The students confirm this by pointing to a number of exams that combine a written part with an oral part afterwards. They also mention that there is some

support for the preparation: They can get samples of previous examinations, and when they are working on their thesis, they can receive keys that give them access to labs where they can use the workplaces and computers. In general, the students have a positive view on the system of examination and grading at the faculty.

The selection of Bachelor's and Master's theses written in English that were presented to the peers gives them the impression of an adequate level of the tasks and demonstrates good performances of the students.

The peers conclude that the number and distribution of the exams ensure that the exam load and preparation times are adequate. The exams are scheduled in order to avoid delays in students' academic progress. Failed exams can be repeated quickly. All exams are marked using transparent criteria.

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

As the faculty does not comment on this chapter of the report, the peers confirm their preliminary assessment without any changes.

4. Resources

Criterion 4.1 Staff

Evidence:

- Statute of the faculty (provided only in Slovenian)
- Faculty Presentation (PowerPoint) with facts and figures
- Teaching Staff Handbook (provided after the on-site visit as requested by the peers)
- Self-Assessment Report
- Discussions with representatives of faculty management, programme coordinators, students, lecturers and business representatives.

Preliminary assessment and analysis of the peers:

As shown in one of the charts of the Faculty Presentation, the teaching staff of the Faculty of Mechanical Engineering is composed of 18 professors (the heads of the 18 chairs), 15 associate professors, 11 assistant professors, three lecturers and 79 teaching assistants (as of 2018). Apart from the teaching staff of altogether 126 persons with full-time employment, 158 researchers and 89 other employees (technical and administrative staff) work at the faculty. Since there are 1,747 students enrolled in the study programmes of the faculty

(including the PhD students and few students in an international joint Master's programme), the ratio between teaching staff and students is approximately 1 to 14.

For appointment procedures, the faculty relies on university-wide rules of appointment to titles in combination with additional rules of the faculty; both have been published on the university web site.

During the on-site visit, the peers learn that the faculty has almost completed a transition process in which a large number of professors who had reached the retirement age have been replaced by younger teaching staff members. With the younger professors, the faculty management is not only aiming at maintaining the quality of education but obviously also at an increase in quantity and quality of research projects, as indicated in the key objective "More top papers and joint EU and ARRS projects" of the faculty's strategy 2019-2025 as well as in the key research achievements displayed in the Faculty Presentation.

The peers also learn that the faculty uses the term "habilitation" in a manner that differs from its meaning in Germany. For the faculty, it is linked with the promotion from the rank of an assistant professor to the higher categories of professors by proving one's quality of education and research. Every five years, the faculty decides who has achieved the status of "habilitation" by the number of courses taught, research papers, etc.

This process is of particular importance for the younger teaching staff members who want to advance in their career. Since many of them attend the discussion panel with the peers, the questions focus on the challenges that they experience. One of them seems to be the uneven distribution of the teaching workload: Professors who have to teach fundamental subjects have a high teaching load while professors with narrow specialisations have fewer teaching hours. Although a higher teaching load offers financial benefits – the number of causes taught influences the salary – it can also limit the time that is left for research, and thereby have unfavourable consequences for one's promotion. Despite such minor problems, the majority of the teaching staff seems to be content with the working conditions at the faculty.

Particularly after the additional submission of a Teaching Staff Handbook that had initially been missing among the appendices to the Self-Assessment Report, the peers consider the composition, scientific orientation and qualification of the teaching staff suitable for sustaining the degree programmes. From their point of view, the quantity of the staff ensures a good ratio between teaching personnel and students.

Criterion 4.2 Staff development

Evidence:

- Self-Assessment Report

- Webpage of the Centre for Pedagogical Education at the Faculty of Arts, University of Ljubljana (http://www.ff.uni-lj.si/an/activities/centre_pedagogical_education, retrieved on 04.02.2019)
- Discussions with representatives of faculty management, programme coordinators and lecturers

Preliminary assessment and analysis of the peers:
In the Self-Assessment Report, the faculty explains that its mission and vision define educational goals for the development and advancement of junior teaching staff. Consequently, the faculty – by relying on university institutions like the Centre for Pedagogical Education – offers the teaching staff regular formal and informal training in postgraduate study education and pedagogic education as well as various short seminars (e.g. a business seminar for young researchers). Between 2013 and 2017, 35 faculty employees made a progression to a higher education degree in formal forms of education while 72 employees participated in different informal forms of education like seminars and workshops. The development of the employees in this field is guided by their supervisor, usually the head of the respective chair or laboratory.

Connected with the explanation about the "habilitation" process, the peers also find out that it is obligatory to attend seminars on pedagogical skills for making this advancement. Apart from that, anyone who wants to promote towards "habilitation" also needs to obtain good results in the student evaluation surveys. Another criterion that positively influences the "habilitation" process is the demonstrated international mobility of higher education teachers. Between 2013 and 2017 30 teachers, assistants and researchers participated in teaching and/or research exchanges of more than 30 days in other EU countries, the USA, Japan and South Africa.

In summary, the peers are convinced that the faculty provides sufficient support mechanisms and opportunities for members of the teaching staff who wish to further develop their professional and teaching skills.

Criterion 4.3 Funds and equipment

Evidence:

- Business and Self-Evaluation Report of the faculty for the year 2016 (provided only in Slovenian)
- Faculty Presentation (PowerPoint) with facts and figures
- List of international co-operation and other projects
- Self-Assessment Report

- Discussions with representatives of faculty management, programme coordinators, students, lecturers and business representatives
- On-site visit of the faculty building including lecture rooms, library and laboratories

Preliminary assessment and analysis of the peers:
As described in the Self-Assessment Report and illustrated in a chart of the Faculty Presentation, the Faculty of Mechanical Engineering is funded from three sources: governmental funding for the execution of the pedagogical activity as its basic mission, governmental and partly EU funding within public research programmes for the execution of scientific research activities, and funding from business partners for activities in the field of applied research and development. The total amount is increasing and surpassed 20 million Euro for the first time in 2018. From 2014 to 2018, the distribution of the sources has remained stable. Between 45 and 50 % of the funding stems from the educational activity, about 35 % from public research programmes, and between 15 and 20 % from industrial research. The faculty admits that the governmental funding is sufficient for basic equipment but the rest is dependent on successful applications in national tenders and on industry cooperation. A big part of research equipment that is also used for educational purposes has been financed from the non-educational funds.

The faculty disposes of three buildings with a usable area of 15,100 m² but has also rented additional rooms outside its premises to cater to the needs of laboratories. The main building hosts two large lecture rooms of 240 and 180 seats respectively, four middle-sized lecture rooms with 110 seats each, 11 classrooms with 40 seats and seven lecture rooms with 20 seats. Lecture rooms are equipped with internet access, video projectors, and partly with audio equipment. For courses in the fields of computer science, numerical methods and modelling, technical documentation and computer-aided design and product analyses, the faculty has fitted six computer classrooms with all necessary equipment to enable small groups of students to work simultaneously. Multiple software licences enable the students to upgrade their knowledge with professional computational software tools. The faculty has its own library and reading room; in reaction to criticism in the student survey and in a joint initiative by students and faculty, this part of the library has recently been reshaped and is now divided into a study room for groups and a “quiet library”. The faculty provides four offices for the Student Organisation and for the Student Council.

Both pedagogical and research work is conducted in 36 laboratories and in two centres of excellence, which are mainly located in the older building of the faculty. As the peers perceive during the on-site visit, a number of laboratories possess high-quality research equipment. However, after the students already made them aware of the problem, the peers recognise that the faculty lacks space. The size of the laboratories often only allows for a

small number of student workplaces, so that it is hard to imagine how larger groups of students can actively use them. This may be one of the reasons why, apart from the faculty management, the students like the idea of constructing a new building on a campus outside the town centre either. In the discussion with the peers, they mention that there is no space for student workshops in the old building, and that they would also welcome to have more space to gather in study groups than is presently available in the main building. According to the plans displayed in the Faculty Presentation, the new buildings would dispose of about 26,000 m², more than 10,000 m² additional space in comparison with the current situation. Since there are still some steps to take before the construction – e.g. the architectural competition in the first half of 2019 –, the peers pick up on the improvement proposals of the students and recommend an augmentation of the number of laboratory workplaces as well as of the space provided for individual self-study and learning groups.

With regard to contractually fixed research cooperation, the faculty has signed long-term agreements on research activity with the Slovenian Research Agency and industrial companies like Gorenje, a large-scale producer of electric household appliances. In 2017, scientific research work was conducted in 15 programme and research groups within the framework of such cooperations. As demonstrated by a list of international cooperation and other projects, the faculty participates in several Horizon 2020 projects and in other European projects. The peers learn from the programme coordinators and the lecturers that money from research projects is not only relevant for the technical equipment but is often also needed for complementing the payment of those researchers who have only few teaching hours and consequently do not receive a full salary.

In summary, the peers acknowledge that the available funds and the equipment form a sound and solid basis for the degree programmes. The lack of space should, however be addressed; the peers would applaud a quick construction of the new faculty building.

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

As the faculty does not comment on this chapter of the report, the peers confirm their preliminary assessment without any changes.

5. Transparency and documentation

Criterion 5.1 Module descriptions

Evidence:

- Study Programme Presentation brochures (available on the faculty website) for all degree programmes
- Course descriptions for all degree programmes.

Preliminary assessment and analysis of the peers:
As the peers notice, the module/course descriptions of all degree programmes are accessible to the students via the student information system VIS as well as to the teaching staff. All modules are tagged with a course identification code. The descriptions include information on the position of the course in the curriculum, the person responsible for the course, the total workload and its composition, the number of ECTS credits, the prerequisites for taking the exam, the content, the objectives and competences, the intended learning outcomes, the learning and teaching methods, the forms of assessment, references to fundamental and to further literature.

The peers therefore confirm that the module descriptions are transparently displayed and contain all necessary information.

Criterion 5.2 Diploma and Diploma Supplement

Evidence:

- Sample Diploma Certificate for all degree programmes
- Sample Transcript of Records for all degree programmes
- Sample Diploma Supplement for all degree programmes

Preliminary assessment and analysis of the peers:
Shortly after graduation, the faculty issues a certificate that confirms the successful graduation whereas the actual degree certificate is awarded twice a year in an official ceremony. A Transcript of Records and a Diploma Supplement will additionally be provided if the student applies for them. The samples used by the faculty show that the documents contain information on the student's qualifications profile and individual performance as well as on the classification of the degree programme with regard to its applicable education system.

Nevertheless, the peers miss sufficient information on the objectives and the learning outcomes in the Diploma Supplement samples. Furthermore, as the faculty admits, they do not include statistical data as set forth in the ECTS User's Guide. The peers insist that both,

objctives and learning outcomes as well as statistical data to support the understanding of the individual result, have to become part of the Diploma Supplement.

Criterion 5.3 Relevant rules

Evidence:

- Statute of the faculty (provided only in Slovenian)
- Study Rules of the faculty (provided only in Slovenian)
- Examination and Assessment Rules of the faculty (provided only in Slovenian)
- Rules about the preparation and presentation of final theses for all degree programmes (provided only in Slovenian)
- Study Programme Presentation brochures (available on the faculty website) for all degree programmes
- Self-Assessment Report

Preliminary assessment and analysis of the peers:

The peers acknowledge that the faculty has devised a number of regulatory documents that, according to the Self-Assessment Report, define the rights and duties of both the university and the students. The relevant rules are laid down in the statutes of the faculty as well as in several other documents on specific subjects. All rules and regulations are published on the website of the faculty, and hence accessible to all relevant stakeholders

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

In its reply to the preliminary report, the faculty states that it has already prepared a template for the inclusion of statistical data in the Diploma Supplements and presents two exemplary diagrams to illustrate how the data could be displayed. The statistics will be determined based on the results of the students that have finished their studies of a particular programme in the previous three years. The faculty also agrees to add information on the objectives and learning outcomes. After a presentation of the renewed versions of the Diploma Supplements in the faculty senate, the faculty will seek the approval of the responsible bodies on university level.

The peers welcome the efforts of the faculty to adjust the Diploma Supplements but suggest a requirement for the time until the changes are implemented.

6. Quality management: quality assessment and development

Criterion 6 Quality management: quality assessment and development

Evidence:

- Regulations for quality assessment and assurance at the faculty (provided only in Slovenian)
- Rules on student surveys at the University of Ljubljana
- Student survey forms for 1st and 2nd cycle degree programmes
- Faculty Presentation (PowerPoint) with facts and figures
- Self-Assessment Report
- Discussions with representatives of faculty management, programme coordinators, students, lecturers and business representatives

Preliminary assessment and analysis of the peers:

In the Self-Assessment Report, the faculty explains how the quality assessment for the study programmes functions as a part of the faculty's quality management system as a whole. It is embedded in a setting of quality goals, regulations and responsible bodies. As for the overall system of quality assurance, the faculty has established "Regulations for quality assessment and assurance" and a Committee for Quality Assurance that monitors general quality-related matters like the self-evaluation of the faculty. The self-evaluation is conducted once a year in preparation of a quality report that is included in the annual business report of the faculty. The students take part in the self-evaluation directly through the student evaluation survey or indirectly through their representatives in the relevant bodies – the Committee for Quality Assurance and the Committees for 1st and 2nd Cycle Studies. Other stakeholders like industrial partners have occasionally been involved by surveys in the past but presently take part in the curriculum discussion in the more institutionalised form of a board for the exchange between professors and business representatives.

The faculty reports that numerous measures have been implemented in recent years as a result of quality assessment and development, e.g. introductory seminars to improve the transition rates between study years, central monitoring of students' presence and fulfilled obligations, replacement of outdated study literature and enlargement of the computer pool for students, appointment of a responsible teacher for student exchange, etc.

The student evaluation survey has been developed by the university administration and is also statistically evaluated on the university level. Two parts of the survey deal with the

performance of the teacher and the features of the course. In the first evaluation, the students are asked to give their opinion on the teacher and the course before the exam. In the second evaluation after the exam, they have the possibility to judge to which extent they acquired the competences listed in the course descriptions and whether the exam was conducted appropriately. The second survey form also includes a question whether the workload was adequate. The third part of the survey deals with general aspects of the study process like the provision of information, rooms and equipment, international mobility, counselling, etc. A fourth part is about mandatory placement in those study programmes that include periods of practical training outside the university. In the Faculty of Mechanical Engineering, the students use the information system VIS to fill in all questionnaires related to the assessment.

The results of the survey are discussed in the Committee for Quality Assurance with student participation. According to a Committee member, an overwhelming majority of the lecturers receive positive evaluations. However, if a lecturer has a particularly low score, he or she will be invited to a talk with the Dean. Furthermore, a member of the Committee will attend his or her lectures and try to give advice how to improve. As the peers find out in the discussion with the lecturers, some of the teachers even organise their own surveys to get more elaborated and helpful comments than from the standardised survey.

Apart from the student evaluation survey, the faculty practices some kind of academic controlling and collects, analyses and processes data on student's learning outcomes. The Student Office keeps track of the progress of students with the help of the student information system VIS.

Finally, as a relatively new quality assurance tool, the faculty introduced a Committee for Thesis Quality Approval that is formed by three teaching assistants who check whether the basic formal requirements (like the number of pages, the citations, etc.) have been met before they forward the thesis to the supervising professor. The professor can thus concentrate on the content, and the faculty makes sure that the decision about the fulfillment of formal requirements always follows the same standard.

To promote Mechanical Engineering studies in general and to make the younger generation curious for engineering topics, the faculty organises events like open house days, summer schools, "Days of Mechanical Engineering" and participation in the "Researchers' Night" at the Technological Museum of Slovenia. The Alumni Club of the faculty supports such efforts to make engineering more popular by lectures for public audiences. To facilitate the access, those lectures are nowadays held at the cultural centre of the town instead of the faculty building.

The peers are impressed by the elaborated quality management system developed by the faculty that covers both the quality assurance for the study programmes and the quality assurance for the faculty as a whole including all services supporting the educational objectives. They confirm that responsibilities and mechanisms are defined and binding, the outcomes and measures are made known to anyone involved, and that the students participate in the quality assurance process not only by surveys but also by representation in the relevant bodies. Apart from the students, other stakeholders like the industrial partners are also involved in the quality assurance process.

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

As the faculty does not comment on this chapter of the report, the peers confirm their preliminary assessment without any changes.

D Additional Documents

No additional documents needed

E Comment of the Higher Education Institution (06.03.2019)

The institution provides a detailed statement.

F Summary: Peer recommendations (11.03.2019)

Taking into account the additional information and the comments given by the Faculty of Mechanical Engineering of the University of Ljubljana 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 Mechanical Engineering – Higher Professional Study Programme	With requirements for one year	EUR-ACE®	30.09.2025
Ba Mechanical Engineering – University Study Programme	With requirements for one year	EUR-ACE®	30.09.2025
Ma Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2025

Requirements

For all degree programmes

A 1. (ASIIN 5.2) Ensure that the Diploma Supplement contains detailed information about the educational objectives and intended learning outcomes, and provide statistical data according to the ECTS-Users' guide in addition to the final grade.

For the Bachelor's programme Mechanical Engineering (University Study Programme)

A 2. (ASIIN 2.2) Ensure that the credits awarded for the Bachelor's thesis correspond with the actual workload of the students.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to re-evaluate the learning outcomes on programme level with particular regard to the EUR-ACE criteria for outcomes of Bachelor's and Master's programmes. It is also recommended to define and document the link between the learning outcomes on programme level and on module level.

E 2. (ASIIN 1.3) It is recommended to strengthen the representation of transferable skills in the curricula.

E 3. (ASIIN 2.3) It is recommended to increase the amount of student group work.

E 4. (ASIIN 4.3) It is recommended to provide more workplaces for students in the laboratories.

E 5. (ASIIN 4.3) It is recommended to provide more space to students for individual self-study and learning groups.

G Comment of the Technical Committee 01 – Mechanical and Process Engineering (14.03.2019)

Assessment and analysis for the award of the ASIIN seal:

The Technical Committee discusses the procedure and follows the assessment of the peers. It suggests one editorial addition to recommendation E 1.

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

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

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

Degree Programme	ASIIN seal	Subject-specific Label	Maximum duration of accreditation
Ba Mechanical Engineering – Higher Professional Study Programme	With requirements for one year	EUR-ACE®	30.09.2025
Ba Mechanical Engineering – University Study Programme	With requirements for one year	EUR-ACE®	30.09.2025
Ma Mechanical Engineering	With requirements for one year	EUR-ACE®	30.09.2025

Requirements

For all degree programmes

A 1. (ASIIN 5.2) Ensure that the Diploma Supplement contains detailed information about the educational objectives and intended learning outcomes, and provide statistical data according to the ECTS-Users' guide in addition to the final grade.

For the Bachelor's programme Mechanical Engineering (University Study Programme)

A 2. (ASIIN 2.2) Ensure that the credits awarded for the Bachelor's thesis correspond with the actual workload of the students.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to re-evaluate the learning outcomes on programme level with particular regard to the EUR-ACE criteria for outcomes of Bachelor's and Master's programmes. It is also recommended to define and document the link between the learning outcomes on programme level and on module/course level.

E 2. (ASIIN 1.3) It is recommended to strengthen the representation of transferable skills in the curricula.

E 3. (ASIIN 2.3) It is recommended to increase the amount of student group work.

E 4. (ASIIN 4.3) It is recommended to provide more workplaces for students in the laboratories.

E 5. (ASIIN 4.3) It is recommended to provide more space to students for individual self-study and learning groups.

H Decision of the Accreditation Commission (29.03.2019)

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

The Accreditation Commission agrees with the requirements and recommendations proposed by the peers and the Technical Committee 01.

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

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

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

Degree Programme	ASIIN-seal	Subject-specific label	Maximum duration of accreditation
Ba Mechanical Engineering – Higher Professional Study Programme	With requirements for one year	EUR-ACE	30.09.2025
Ba Mechanical Engineering – University Study Programme	With requirements for one year	EUR-ACE	30.09.2025
Ma Mechanical Engineering	With requirements for one year	EUR-ACE	30.09.2025

Requirements

For all degree programmes

A 1. (ASIIN 5.2) Ensure that the Diploma Supplement contains detailed information about the educational objectives and intended learning outcomes, and provide statistical data according to the ECTS-Users' guide in addition to the final grade.

For the Bachelor's programme Mechanical Engineering (University Study Programme)

A 2. (ASIIN 2.2) Ensure that the credits awarded for the Bachelor's thesis correspond with the actual workload of the students.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to re-evaluate the learning outcomes on programme level with particular regard to the EUR-ACE criteria for outcomes of Bachelor's and Master's programmes. It is also recommended to define and document the link between the learning outcomes on programme level and on module/course level.

E 2. (ASIIN 1.3) It is recommended to strengthen the representation of transferable skills in the curricula.

E 3. (ASIIN 2.3) It is recommended to increase the amount of student group work.

E 4. (ASIIN 4.3) It is recommended to provide more workplaces for students in the laboratories.

E 5. (ASIIN 4.3) It is recommended to provide more space to students for individual self-study and learning groups.

I Fulfilment of Requirements (06.12.2019)

Analysis of the peers and the Technical Committee 01 (18.11.2019)

Requirements

For all degree programmes

A 3. (ASIIN 5.2) Ensure that the Diploma Supplement contains detailed information about the educational objectives and intended learning outcomes, and provide statistical data according to the ECTS-Users' guide in addition to the final grade.

Initial Treatment	
Peers	A1. fulfilled Justification: The university handed in three individual diploma supplements for each degree programme with the required information about the educational objectives, intended learning outcomes and the statistical data according to the ECTS guide.
TC 01	fulfilled Vote: unanimous Justification: The technical committee agrees with the peers' assessment.

For the Bachelor's programme Mechanical Engineering (1st cycle University Study Programme)

A 4. (ASIIN 2.2) Ensure that the credits awarded for the Bachelor's thesis correspond with the actual workload of the students.

Initial Treatment	
Peers	A 2. fulfilled Justification: The university analysed that the average number of pages in the Bachelor's Programme Mechanical Engineering is too high. Thus, the university limits the number of pages for a Bachelor thesis to a maximum of 30 pages to better reflect the allocated ECTS points for the thesis. The university delivers a document about the instructions how to write a final thesis and mentions the new rule under Point 2.

	The document about the rules of graduation explicitly specifies maximum the number of 30 pages for a thesis on page 4 (Article 14). The document about the senate decision confirms that the university adopts these changes under Decision 3.
TC 01	fulfilled Vote: unanimous Justification: The technical committee agrees with the peers' assessment.

Decision of the Accreditation Commission (06.12.2019)

Degree Programme	ASIIN-label	Subject-specific label	Accreditation until max.
Ba Mechanical Engineering – Higher Professional Study Programme	Requirements fulfilled	EUR-ACE	30.09.2025
Ba Mechanical Engineering – University Study Programme	Requirements fulfilled	EUR-ACE	30.09.2025
Ma Mechanical Engineering	Requirements fulfilled	EUR-ACE	30.09.2025

Appendix: Programme Learning Outcomes and Curricula

According to the Study Programme Information brochure (Predstavitveni Zbornik, only in Slovenian, translation taken from the Self-Assessment Report) the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Bachelor's degree programme Mechanical Engineering (Higher Professional Study Programme):

"The objectives and learning outcomes of the degree programme:

The first main objective of 1st Cycle Professional Study Programme in Mechanical Engineering - Project Oriented Applied Programme at University of Ljubljana, Faculty of Mechanical Engineering (UL FME) is to cater to the demands and wishes of the national economy, and thereby also fulfil the student's desire to obtain the necessary competences that will guarantee him or her direct employability after the conclusion of study, and in line with this:

- equip the graduate with appropriate fundamental engineering knowledge and with necessary applied knowledge in the selected field of mechanical engineering to achieve corresponding employability;
- make it possible for the graduate to comprehend the assimilated knowledge in the field of mechanical engineering;
- to provide the graduate with adequate erudition over a wide area of mechanical engineering, so that he or she will be capable of interdisciplinary collaboration with experts from the other fields.

The second main objective of the study programme is to follow the principles of the Bologna declaration. Through improved optionality and mobility, it should provide European comparable knowledge and employment qualifications of its graduates that are supported by the corresponding studying directions (modules). In line with that:

- a graduate should get the education, comparable with similar study programmes in Central and Western Europe;
- the credits assessed certificate of accomplished study requirements makes it possible for a student to change for another similar undergraduate study programme in Slovenia or abroad;
- with conditions for migrations across study programmes, with the education work methods, encouraging continuous studying, and with the tutoring system, conditions for students' smooth migrations are provided.

The aims and learning outcomes:

In order to meet the desired objectives to the greatest extent possible, emphasis will be placed on:

- first and foremost, making it possible for the student to attain the necessary fundamental knowledge, including the critical technical knowledge specific to a module, and at the same time placing an accent on the cross-curricular nature of mechanical engineering, and linking and upgrading this knowledge in the project oriented applied program. In this way we attempt to motivate the student for quality practical work or to pursue the 2nd cycle study. In addition, the students also acquire the indispensable skills related to the modern technical computer-supported communication and computational analysis;
- the student consciously developing critical scientific thinking, supported by suitable methodological approaches, as a pillar for later professional work.

The graduate is expected to master the following general competences upon completing the 1st Cycle Professional Study Program in Mechanical Engineering - Project Oriented Applied Program:

- the ability to use the attained knowledge in the practice,
- the ability to work autonomously in the framework of knowledge provided by the selected study module,
- the ability to manage their time,
- the ability to break down professional tasks of lesser complexity into subtasks,
- developing the ability of critical and self-critical thinking,
- qualification for teamwork and establishing interdisciplinary relations with the professionals from other disciplines,
- the ability to manage a technological unit or project,
- adaptability to changing working situations,
- considering the safety, functional, economic and environmental principles in their work,
- the ability to communicate professionally and express oneself in writing,
- the ability to present professional problems and the solutions thereof in own environment and wider,
- the ability to use information and communications technology,
- the ability to find sources of knowledge, select among the available resources and use the knowledge acquired for one’s work,
- learning the indispensable technical vocabulary in English or German language,
- developing professional responsibility and ethics,

- respecting the engineering code.

The graduate is expected to master the following subject-specific competences upon completing the 1st Cycle Professional Study Program in Mechanical Engineering - Project Oriented Applied Program:

- understanding the laws of physics and the phenomena behind the operating principles of products and technologies,
- mastering the most important concepts of higher mathematics and numerical analysis,
- mastering the fundamental specialised knowledge in the field of mechanical engineering (technical documentation, mechanics, thermodynamics, machine elements, technological processes, quality) and the fundamental complementary sciences (metal and non-metal materials, electrical engineering, IT, organisational science and economics),
- knowing the basic measuring instruments and measuring chains used to measure the basic quantities in the field of mechanical engineering,
- knowing the main environmental restrictions and problems,
- mastering independent project work,
- knowing some software tools necessary for computer data processing,
- mastering the basic and required specific knowledge from the selected study field (power, process and environmental engineering; engineering design, machine operation and maintenance; production engineering; mechatronics; aviation),
- the graduates are able to independently perform applied developmental, engineering and professional organisational work, and to solve well-defined individual tasks in the field of mechanical engineering."

The following **curriculum** is presented in the Study Programme Information brochure (English version):

Table 9.2a: Year 1 Curriculum

YEAR 1	Course set	Contact lessons					ΣSW	ΣWR*	ECTS*
		L	S	W	OW	ΣCL			
1st semester									
Engineering Mathematics 1	CGC	30		45		75	75	150	6
Engineering Physics	CGC	45		30		75	100	175	7
Technical Documentation	CSC	30		45		75	75	150	6
Electrical Engineering and Electronics	CSC	30		30		60	65	125	5
Energetics and Environment	CSC	30	15			45	30	75	3
Informatics and Computing	CGC	15		30		45	30	75	3
1st semester total		**180**	**15**	**180**		**375**	**375**	**750**	**30**
2nd semester									
Engineering Mathematics 2	CGC	45		30		75	75	150	6
Engineering Mechanics 1	CSC	75		45		120	130	250	10
Product Conceptualisation & Systems Design	CSC	30		30		60	65	125	5
Mesurement	CSC	30		30		60	65	125	5
Production Engineering	CSC	45	15			60	40	100	4
2nd semester total		**225**	**15**	**135**		**375**	**375**	**750**	**30**
1st and 2nd semesters total		**405**	**30**	**315**		**750**	**750**	**1500**	**60**

Table 9.2b: Year 2 Curriculum

YEAR 2 [1,2]	Course set	Contact lessons					ΣSW	ΣWR*	ECTS*
		L	S	W	OW	ΣCL			
3rd semester									
Engineering Materials	CSC	45		30		75	50	125	5
Engineering Thermodynamics 1	CSC	45		30		75	75	150	6
Engineering Mechanics 2	CSC	60		45		105	95	200	8
Machine Elements 1	CSC	45		30		75	75	150	6
Compulsory module course S1 [3,4]	CSC	30		30		60	65	125	5
3rd semester total [4]		**225**		**165**		**390**	**360**	**750**	**30**
4th semester									
Heat and Mass Transfer	CSC	30		30		60	65	125	5
Machine Elements 2	CSC	45		30		75	50	125	5
Programming and Numerical Methods	CGC	30		30		60	65	125	5
Fundamentals of Control	CSC	30		30		60	65	125	5
Compulsory module course S2 [3,4]	CSC	30		30		60	65	125	5
Compulsory module course S3 [3,4]	CSC	30		30		60	65	125	5
4th semester total [4]		**180**		**195**		**375**	**375**	**750**	**30**
3rd and 4th semesters total [4]		**405**		**360**		**765**	**735**	**1500**	**60**

Table 9.2b-1: Compulsory module course sets in Year 2

YEAR 2 – Compulsory module courses S1-S3		Contact lessons L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
Module: POWER, PROCESS AND ENVIRONMENTAL ENGINEERING									
S1	Energy Production	30		30		60	65	125	5
S2	Engineering Thermodynamics 2	30		30		60	65	125	5
S3	Energy Supply	30		30		60	65	125	5
Module: ENGINEERING DESIGN, MACHINE OPERATION AND MAINTENANCE									
S1	Engineering Design Methodology	30		30		60	65	125	5
S2	Products Effectiveness	30		30		60	65	125	5
S3[3]	Engineering Mechanics 3	30		30		60	65	125	5
	Fundamentals of FE Analysis	30		30		60	65	125	5
Module: PRODUCTION ENGINEERING									
S1	Technology of Materials	30		30		60	65	125	5
S2	Technology of Cutting Processes	30		30		60	65	125	5
S3	Technology of Forming Processes	30		30		60	65	125	5
Module: MECHATRONICS									
S1	Engineering Design Methodology	30		30		60	65	125	5
S2	Programmable Logic Controllers	30		30		60	65	125	5
S3	Introduction to Software Engineering	30		30		60	65	125	5
Module: AVIATION									
S1	Flight Instruments	45		15		60	65	125	5
S2	Aircraft Aeromechanics	40		20		60	65	125	5
S3[4]	Aviation Meteorology	50		30		80	45	125	5
	Non-destructive Testing	30		30		60	65	125	5
3rd and 4th semesters total (AHP)[5]		450		335		785	715	1500	60
3rd and 4th semesters total (ADM)[6]		430		335		765	735	1500	60

Table 9.2c-S: Year 3 Curriculum for modules: Power, Process and Environmental Engineering; Engineering Design, Machine Operation and Maintenance; Production Engineering and Mechatronics

YEAR 3 – PPE, DOM, PRO and MEC	Course set	Contact lessons L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
5th semester									
Compulsory module course S4[7]	CSC	30		30		60	65	125	5
Compulsory module course S5[7]	CSC	30		30		60	65	125	5
Elective module course M1[8]	ESC	30		30		60	40	100	4
Elective module course M2[8]	ESC	30		30		60	40	100	4
Elective programme course P1[9]	ESC	30		30		60	40	100	4
Elective programme course P2[10]	ESC	30		30		60	40	100	4
Elective general course 01[11]	EGC							100	4
5th semester total		180[11+]		180[11+]		360[11+]	290[11+]	750	30
6th semester									
Elective module course M3[8]	ESC	30		30		60	65	125	5
Elective general course 02[11]	EGC							125	5
Practical Training	CSC				19		0	200	8
		5		0	5	200			
Diploma Work	CSC				16		100	300	12
		40		0	0	200			
6th semester total		75[11+]		30[11+]	355	460[11+]	165[11+]	750	30
5th and 6th semesters total		255[11+]		210[11+]	355	820[11+]	455[11+]	1500	60

Table 9.2c-L: Year 3 Curriculum for module: Aviation

YEAR 3 – AVI (AHP/ADM)	Course set	Contact lessons L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
5th semester									
Compulsory module course S4[7]	CSC	45		15		60	65	125	5
Compulsory module course S5[7]	CSC	30		15		45	30	75	3
Compulsory module course S6[7]	CSC	30		15		45	30	75	3
Elective module course M1[8]	ESC	60/45		45/30		105/75	45/75	150	6
Elective module course M2[8]	ESC	30		30		60	40/65	100/125	4/5
Elective programme course P1[9]	ESC	30		30		60	40	100	4
Elective general course 01[11]	EGC							125/100	5/4
5th semester total (AHP)[5]		225[11+]		150[11+]		375[11+]	250[11+]	750	30
5th semester total (ADM)[5]		210[11+]		135[11+]		345[11+]	305[11+]	750	30
6th semester									
Elective module course M3[8+]	ESC	115/30		15/30		130/60	20/65	150/125	6/5
Elective general course 02[11]	EGC							100/125	4/5
Practical Training[10]	CSC	5		0	195	200	0	200	8
Diploma Work	CSC	40		0	160	200	100	300	12
6th semester total (AHP)[5]		160[11+]		15[11+]	355	530[11+]	120[11+]	750	30
6th semester total (ADM)[6]		75[11+]		30[11+]	355	460[11+]	165[11+]	750	30
5th and 6th semesters total (AHP)[5]		385[11+]		165[11+]	355	905[11+]	370[11+]	1500	60
5th and 6th semesters total (ADM)[6]		285[11+]		165[11+]	355	805[11+]	470[11+]	1500	60

Table 9.2c-1: Compulsory module course sets in Year 3

YEAR 3 – Compulsory module courses S4-S6	Contact lessons L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
Module: POWER, PROCESS AND ENVIRONMENTAL ENGINEERING								
S4 Energy Use	30		30		60	65	125	5
S5 Fluid Movers	30		30		60	65	125	5
Module: ENGINEERING DESIGN, MACHINE OPERATION AND MAINTENANCE								
S4 Hydraulics and Pneumatics	30		30		60	65	125	5
S5 Investment Engineering & Project Management	30		30		60	65	125	5
Module: PRODUCTION ENGINEERING								
S4 Process Planning	30		30		60	65	125	5
S5 Investment Engineering & Project Management	30		30		60	65	125	5
Module: MECHATRONICS								
S4 Introduction to Mechatronic Systems	30		30		60	65	125	5
S5 Investment Engineering & Project Management	30		30		60	65	125	5
Module: AVIATION								
S4 Aircraft Engines 1	45		15		60	65	125	5
S5 Aircraft Systems	30		15		45	30	75	3
S6 Aircraft Structures	30		15		45	30	75	3

Table 9.2c-2: Elective sub-module course sets in Year 3

YEAR 3 – Elective sub-module courses M1-M3	Contact lessons L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
Module: POWER, PROCESS AND ENVIRONMENTAL ENGINEERING								
Sub-module: POWER ENGINEERING								
M1 Internal Combustion Engines	30		30		60	40	100	4
M2 Effectiveness & Reliability of Energy Systems	30		30		60	40	100	4
M3 Advanced Technologies in Energetics	30		30		60	65	125	5
Sub-module: HOUSEHOLD AND SANITARY TECHNOLOGY								
M1 Building Services Engineering	30		30		60	40	100	4
M2 Heating, Cooling and Air Conditioning	30		30		60	40	100	4
M3 Renewable Energy Sources	30		30		60	65	125	5
Sub-module: PROCESS ENGINEERING								
M1 Process Engineering	30		30		60	40	100	4
M2 Tests Design & Validation of Process Systems	30		30		60	40	100	4
M3 Environmental Process Technology	30		30		60	65	125	5

Module: ENGINEERING DESIGN, MACHINE OPERATION AND MAINTENANCE

Sub-module: MATERIAL HANDLING AND SELF-PROPELLED MACHINES

M1	Steel Structures	30	30	60	40	100	4
M2	Design of Self-propelled Machines	30	30	60	40	100	4
M3	Power Drives	30	30	60	65	125	5

Sub-module: VEHICLE ENGINEERING

M1	Theory of Machines and Mechanisms	30	30	60	40	100	4
M2	Vehicle Engineering	30	30	60	40	100	4
M3	Traffic Logistics	30	30	60	65	125	5

Sub-module: MAINTENANCE MANAGEMENT

M1	Technical Diagnostics	30	30	60	40	100	4
M2	Design of Self-propelled Machines	30	30	60	40	100	4
M3	Power Drives	30	30	60	65	125	5

Module: PRODUCTION ENGINEERING

Sub-module: PRODUCTION TECHNOLOGIES

M1	Assembling Technology	30	30	60	40	100	4
M2	Alternative Technologies	30	30	60	40	100	4
M3	Quality Assurance	30	30	60	65	125	5

Sub-module: PRODUCTION MANAGEMENT

M1	Handling Systems	30	30	60	40	100	4
M2	Technology Planning and Product Design	30	30	60	40	100	4
M3	Production Management	30	30	60	65	125	5

Sub-module: WELDING TECHNOLOGIES

M1	Joining Technology	30	30	60	40	100	4
M2	Welding Process Equipment	30	30	60	40	100	4
M3	Materials and Product Testing	30	30	60	65	125	5

Module: MECHATRONICS

Sub-module: MECHATRONICS

M1	Controlled Electric Devices	30	30	60	40	100	4
M2	Industrial Automation	30	30	60	40	100	4
M3	Hydraulic and Pneumatic Systems	30	30	60	65	125	5

Module: AVIATION

Sub-module: AIRPLANE PILOT / HELICOPTER PILOT

M1	Air Navigation 1	60	45	105	45	150	6
M2	Aviation Phraseology	30	30	60	40	100	4
M3[a]	Aviation Law and Regulations	45	15	60	15	75	3
M3[b]	Aviation Medicine and Psychology	70	0	70	5	75	3

Sub-module: AIRCRAFT DESIGN AND MAINTENANCE

M1	Light Aircraft Structures	45	30	75	75	150	6
M2	Aircraft Maintenance	30	30	60	60	125	5
M3	Aircraft Design	30	30	60	65	125	5

Table 9.2c-3: Elective programme course sets in Year 3 (linked choice)

YEAR 3 – Elective programme course P1	Contact lessons							
	L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
Mechanics of Non-metallic Materials[1]	30		30		60	40	100	4
Maintenance Technology[1]	30		30		60	40	100	4
Mechanics of Aircraft Flight [2]	30		30		60	40	100	4
Mechanics of Helicopter Flight [2]	30		30		60	40	100	4

Table 9.2c-4: Elective programme courses in Year 3 (free choice)

YEAR 3 – Elective programme course P2	Contact lessons							
	L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
Construction Materials	30		30		60	40	100	4
Plastic Product Design and Manufacturing	30		30		60	40	100	4
Heat Pumps	30		30		60	40	100	4
Precision Engineering	30		30		60	40	100	4
Heat Treatment Design	30		30		60	40	100	4
Joining and Heat Cutting of Materials	30		30		60	40	100	4
Computer Integrated Manufacturing	30		30		60	40	100	4
Engineering Acoustics	30		30		60	40	100	4
Materials in Power and Process Engineering	30		30		60	40	100	4
Lubrication Engineering	30		30		60	40	100	4
Production Metrology	30		30		60	40	100	4
Hydropower Systems	30		30		60	40	100	4
Welded Structures	30		30		60	40	100	4
Fundamentals of Laser Technology	30		30		60	40	100	4
Vehicle Transmissions	30		30		60	40	100	4
Wear Resistance Surface Engineering	30		30		60	40	100	4
Material Handling Systems	30		30		60	40	100	4
Materials Weldability	30		30		60	40	100	4
Mechanical Process Engineering	30		30		60	40	100	4
Machine Tool Design	30		30		60	40	100	4

Table 9.2c-5: Elective general courses in Year 3 (offered by the Faculty)

YEAR 3 – Elective general courses	Contact lessons							
	L	S	W	OW	ΣCL	ΣSW	ΣWR*	ECTS*
Aircraft Operating Procedures	30		0		30	45	75	3
Helicopter Operating Procedures	30		0		30	45	75	3
Material Handling and Warehousing	30		30		60	40	100	4
Aircraft Engines 2	30		30		60	40	100	4
Sanitary and Fire Protection Engineering	30		30		60	40	100	4
Polymer Technology	30		30		60	40	100	4
Technical Safety	30		30		60	40	100	4
Computer Data Processing Fundamentals	30		30		60	60	100	4
Air Navigation 2	50		45		95	30	125	5
Aircraft Performance	60		60		120	5	125	5
Helicopter Performance	60		60		120	5	125	5

L - lectures	CL - contact lessons	CGC - Compulsory general course
S - seminar	SW - hours of student's personal work	CSC - Compulsory specialised course
W - laboratory work	WR - total work required	ESC - Elective specialised course
OW - other work	CS - course set	EGC - Elective general course

According to the Study Programme Information brochure (English version) the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Bachelor's degree programme Mechanical Engineering (University Study Programme):

"The Fundamental Programme Objectives

The main objectives of Level 1 Undergraduate University Study Programme Mechanical Engineering – Research and Development Programme are as follows:

- To follow national economy's as well as students' requirements and requests to acquire the necessary competences that would provide direct employability after the end of studying. In line with this, it should provide a graduate with
    - broad and basic engineering skills, especially quality mechanical engineering skills and thus adequate employability,
    - solid fundamental knowledge and understanding of a wide range of mechanical engineering topics,
    - necessary skills to continue studying on the postgraduate level – Level 2.
    - broad mechanical engineering knowledge and skills, making him or her capable of linking different areas together in an interdisciplinary way.
- To follow the principles of the Bologna declaration, the European University Association EUA, the European Federation of National Engineering Associations FEANI and the German Accreditation Agency ASIIN. Through improved optionality and mobility, it should provide European comparable knowledge and employment qualifications of its graduates. In line with that:
    - a graduate should get the education, comparable with similar study programmes in Central and Western Europe,
    - the credits assessed certificate of accomplished study requirements makes it possible for a student to change for another similar undergraduate study programme in Slovenia or abroad
    - with conditions for migrations across study programmes, with the education work methods, encouraging continuous studying, and with the tutoring system, conditions for students' smooth migrations are provided.

General Competences, Acquired Through the Programme

After completing Level 1 undergraduate university study programme Mechanical Engineering – Research and Development Programme, the graduate will have the following general competences:

- The ability to define, understand and creatively solve professional challenges.
- Development of creative, analytical and synthetic thinking.

- Development of professional responsibility and ethics.
- Professional communication and writing communication skills, including the use of foreign technical language.
- The ability to use information and communication technology.
- The ability to use the acquired knowledge to solve professional engineering problems independently.
- The ability to find sources, make critical judgement of information, upgrade the acquired skills independently and further develop the knowledge on various specific areas of engineering.
- The ability for teamwork and establishing interdisciplinary partnerships.
- Following safety, functional, economic and environmental principles at their work.
- Respecting the engineering code.

Course-Specific Competences, Acquired Through the Programme

After completing Level 1 undergraduate university study programme Mechanical Engineering – Research and Development Programme, the graduate will have the following course-specific competences:

- Mastery of basic theoretic skills, fundamental to the technical aspect of mechanical engineering.
- Mastery of basic professional mechanical engineering skills and the fundamental complementary sciences (metallurgy, informatics and organisational sciences).
- Having basic engineering competence, which allows him/her to carry on studying on Level 2.
- The ability to acquire new knowledge and skills independently.
- A Level 1 graduate is able to perform easier development, engineering and professional organisational tasks as well as to solve individual well-defined engineering tasks.
- Specific competences are described in work plans for each course."

The following **curriculum** is presented in that brochure:

YEAR 1	Course set	Contact lessons				ΣSW	ΣWR*	ECTS*
		L	S	W	ΣCL			
1st semester								
Mathematics 1	CGC	45		45	90	135	225	9
Statics and Kinematics	CSC	45		30	75	75	150	6
Descriptive Geometry and Tech. Documentation	CSC	45		45	90	85	175	7
Energy and Environment	CSC	45		15	60	40	100	4
Elective course 01 [1]	EGC						100	4
1st semester total		**180** [1+]		**135** [1+]	**315** [1+]	**335** [1+]	**750**	**30**
2nd semester								
Mathematics 2	CGC	45		45	90	110	200	8
Physics	CGC	60		45	105	95	200	8
Strength of Materials	CSC	45		30	75	75	150	6
Engineering Materials 1	CSC	30		15	45	30	75	3
Space Modelling and Representation	CSC	30		30	60	65	125	5
2nd semester total		**210**		**165**	**375**	**375**	**750**	**30**
1st and 2nd semester total		**390** [1+]		**300** [1+]	**690** [1+]	**710** [1+]	**1500**	**60**

YEAR 2	Course set	Contact lessons				ΣSW	ΣWR*	ECTS*
		L	S	W	ΣCL			
3rd semester								
Mathematics 3	CGC	45		30	75	75	150	6
Thermodynamics	CSC	60		30	90	110	200	8
Engineering Materials 2	CSC	45		30	75	50	125	5
Machine Elements 1	CSC	45		30	75	75	150	6
Numerical methods	CGC	30		30	60	65	125	5
3rd semester total		**225**		**150**	**375**	**375**	**750**	**30**
4th semester								
Fluid Mechanics	CSC	60		30	90	85	175	7
Heat Transfer	CSC	45		30	75	75	150	6
Machine Elements 2	CSC	45		30	75	75	150	6
Manufacturing Technologies 1	CSC	45		15	60	65	125	5
Project management	CSC	30		15	45	30	75	3
Elective course 02 [2]	EGC						75	3
4th semester total		**225** [2+]		**120** [2+]	**345** [2+]	**330** [2+]	**750**	**30**
3rd and 4th semester total		**450** [2+]		**270** [2+]	**720** [2+]	**705** [2+]	**1500**	**60**

YEAR 3	Course set	Contact lessons				ΣSW	ΣWR*	ECTS*
		L	S	W	ΣCL			
5th semester								
Numerical Modelling Methods	CGC	45		30	75	100	175	7
Measurement Techniques	CSC	45		30	75	75	150	6
Elective course 1 [4]	ESC	45		30	75	100	175	7
Elective course 2 [4]	ESC	30		30	60	65	125	5
Elective course 3 [4]	ESC	30		30	60	65	125	5
5th semester total		**195**		**150**	**345**	**405**	**750**	**30**
6th semester								
Design Methodology	CSC	30		30	60	65	125	5
Tribology	CSC	30		30	60	65	125	5
Elective course 4 [4]	ESC	30		30	60	65	125	5
Elective course 5 [4]	ESC	30		30	60	65	125	5
Elective course 6 [4]	ESC	30		30	60	65	125	5
Elective course 03 [3]	EGC						125	5
6th semester total		**150** [3+]		**150** [3+]	**300** [3+]	**325** [3+]	**750**	**30**
5th and 6th semester total		**345** [3+]		**300** [3+]	**645** [3+]	**730** [3+]	**1500**	**60**

Elective specialised courses		Contact lessons							
		Range	L	S	W	ΣCL	ΣSW	ΣWR*	ECTS*
24	Rigid Body Dynamics	3-A	45		30	75	100	175	7
25	Fluid Dynamics	3-A	45		30	75	100	175	7
26	Product Design and Development	3-B	30		30	60	65	125	5
27	Energy Machines and Apparatus	3-B	30		30	60	65	125	5
28	Manufacturing Technologies 2	3-B	30		30	60	65	125	5
29	Polymer Science	3-B	30		30	60	65	125	5
30	Fundamentals of Mechatronics	3-C	30		30	60	65	125	5
31	Technical Acoustics	3-C	30		30	60	65	125	5
32	Internal Environment	3-D	30		30	60	65	125	5
33	Hydraulics and Pneumatics	3-D	30		30	60	65	125	5
34	Production Engineering	3-D	30		30	60	65	125	5
35	Laser Systems	3-D	30		30	60	65	125	5

Elective general courses, offered by UL FME		Contact lessons							
		Range	L	S	W	ΣCL	ΣSW	ΣWR*	ECTS*
36	Electrical Engineering	1-S	30		15	45	55	100	4
37	Chemistry	1-S	30		15	45	55	100	4
38	Fundamentals of Quality	2-S	30		0	30	45	75	3
39	Enterprise Economics	2-S	30		0	30	45	75	3
40	Practical Training	3-S	0		0	0	125	125	5

L - lectures	CL - contact lessons	CGC - Compulsory general course
S - seminar	SW - hours of student's personal work	CSC - Compulsory specialised course
W - laboratory work	WR - total work required	ESC - Elective specialised course
OW - other work	CS - course set	EGC - Elective general course

According to the Study Programme Information brochure (Predstavitveni Zbornik, only in Slovenian, translation taken from the Self-Assessment Report) the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Mechanical Engineering:

"The objectives and learning outcomes of the degree programme:

Aiming to provide the conditions for an improved competitive position of Slovenian economy in the globalised world markets, mainly on the basis of its capability to design and develop new products, process technologies and technological processes, at the same time abiding by the criteria of sustainable development and environmental protection, the first main objective of the Level 2 Masters' study program Mechanical Engineering – Research and development program at UL FME is to educate the masters of mechanical engineering, who will be qualified to do autonomous research and development and applied project work, as well as to create new knowledge both in different disciplines of mechanical engineering and in the fields which require interdisciplinary collaboration. Accordingly, we define the key factor of the program to be its ability to cater to the demands and needs of national economy, and in turn also the students' aspirations to gain the necessary qualifications and competences that will guarantee him or her direct employability after the conclusion of study.

The second main objective of the study programme is to follow the principles of the Bologna declaration. Through improved optionality and mobility, it should provide European comparable knowledge and employment qualifications of its graduates in different professional fields that are supported by the corresponding studying directions (modules). In line with that:

- a graduate should get the education, comparable with similar study programmes in Central and Western Europe;
- the credits assessed certificate of accomplished study requirements makes it possible for a student to change for another similar undergraduate study programme in Slovenia or abroad;
- with conditions for migrations across study programmes, with the education work methods, encouraging continuous studying, and with the tutoring system, conditions for students' smooth migrations are provided.

[…]

The aims and learning outcomes:

In order to meet the desired objectives to the greatest extent possible, emphasis will be placed on:

- making it possible for the student to attain in-depth fundamental and specialised professional-engineering knowledge in the field of mechanical engineering. In this way the students are qualified to take professional responsibility for solving demanding real-life professional problems, the solutions to which are often accompanied by new value added. The graduates of 2nd Cycle Master's Study Program in Mechanical Engineering - Development Research Program thereby become indispensable for the blossoming of national economy;
- the student, who gains a wider fundamental knowledge base and uses the attained knowledge to cover and have command of basic professional fields of mechanical engineering, will develop a scientific way of thinking in research work, supported by the methodological approaches learned. In this way the students become qualified to solve developmental tasks, the solutions to which generally guarantee the companies survival in the international market;
- the student learns the significance of interdisciplinary collaboration in the process of developing new products and technologies. By their knowledgeability, training to think analytically, and command of methodologies and approaches for research and development work in various professional branches of mechanical engineering, the masters of mechanical engineering will gain the knowledge and the ability of interdisciplinary linking various fields. This also fulfils the basic requirements for a successful continuation of study on the 3rd doctoral study level.

The general competences and qualifications expected of masters of mechanical engineering after the conclusion of 2nd Cycle Master's Study Program in Mechanical Engineering - Development Research Program include:

- the ability to define and understand fundamental scientific problems and to creatively deal with professional challenges;
- improved capability of critical, analytical and synthetical thinking. Development of new knowledge and comprehension of the professional field. Development of higher cognitive skills, related to the creation of new knowledge;
- the ability to assume responsibility for one's own professional development and learning by evaluation and reflection on one's own work (learning by experience, supervision);
- autonomous work in different social activities and liberal professions;
- the ability to do professional communication and express oneself in writing, also internationally;

- the ability to use information and communications technology;
- the qualification to use the attained knowledge to autonomously solve technical problems in mechanical engineering;
- ability to find sources, critically evaluate information, independently upgrade the attained knowledge and deepen the knowledge in the individual specialised fields of mechanical engineering;
- ability for teamwork and for interdisciplinary networking. Establishing partner relationships with users and other groups. Managerial and organisational skills;
- the ability to use modern research methods and procedures. Capacity to research and transfer the findings into practice.

The subject-specific competences and qualifications expected of masters of mechanical engineering after the conclusion of the 2nd Cycle Master's Study Program in Mechanical Engineering - Development Research Program are:

- the ability to upgrade and use the fundamental mechanical engineering knowledge, including the developmental-technical implementation thereof;
- using the fundamental theoretical and applied knowledge, crucial for having command of technical field of mechanical engineering;
- a broad qualification in the field of mechanical engineering as a prerequisite for continuing the study on the doctoral study program;
- the ability for physical, mathematical and numerical modelling of problems, including a developed ability to critically analyse the results;
- the ability to autonomously acquire new knowledge and skills;
- the ability to autonomously perform demanding research, developmental, engineering and professionally-organisational work, the ability to creatively solve individual tasks in the field of mechanical engineering;
- the ability to find optimal solutions based on analysis and synthesis.

The subject-specific competences and qualifications acquired by a master professor of mechanical engineering in the Engineering pedagogy module are as follows:

- recognition and solving of professional issues in education and schooling;
- using some research approaches in education and schooling;
- in-depth knowledge in the broader professional fields of education;
- critical following of latest developments in the theory and practice of education;
- taking responsibility for managing the education process;
- capability of establishing connections between courses and cross-curricular connections, having a comprehensive view on the education process;
- the ability for critical (self)reflection and (self)evaluation of education work and research work;

- the ability to form new ideas (creativity) in the field of education and schooling;
- the ability to do autonomous work in education and schooling;
- the ability to work based on ethical judgement.

The following **curricula** for the different fields of specialisation are presented in the Study Programme Information brochure (English version):

Table 4.5.5-S01a: Syllabus – **Mechanics of Materials, Systems and Processes**

Year 1

1st semester	ECTS
Mathematics 4	5
Experimental Methods	5
Advanced Dynamics	5
Machine Elements 3	5
Engineering Design Techniques	5
Elective General Course S01[1]	5

2nd semester	ECTS
Continuum Mechanics	6
Computer Aided Structural Analysis	6
Structural Evaluation	6
Structural Stability	6
Structural Mechanics	6

Year 2

3rd semester	ECTS
Random Phenomena	5
Mechanics of Polymers & Composites	5
Mechanisms	5
Dynamics of Machines	5
Thermomechanics	5
Plastomechanics	5

4th semester	ECTS
Elective General Course S02[1]	5
Elective General Course S03[1]	5
Master's Practicum	5
Master's Thesis	15

Table 4.5.5-S01b: Syllabus – **Engineering Design and Product Development**

YEAR 1

1st semester	ECTS
Experimental Methods	5
Random Phenomena	5
Advanced Dynamics	5
Machine Elements 3	5
Engineering Design Techniques	5
Elective General Course S01[1]	5

2nd semester	ECTS
Continuum Mechanics	6
Computer Aided Structural Analysis	6
Structural Evaluation	6
Material Handling Systems	6
Mechanical Power Drives	6

YEAR 2

3rd semester	ECTS
Technical Cybernetics	5
Mechanisms	5
Nanotechnology	5
Product Reliability	5
Elective General course S02[1]	5
Elective General course S03[1]	5

4th semester	ECTS
Operational Strength	5
Plastic Product Design and Manufacturing	5
Master's Practicum	5
Master's Thesis	15

Table 4.5.5.-S02a: Syllabus – **Thermal and Process Engineering**

YEAR 1

Semester 1	ECTS
Mathematics 4	5
Transport Phenomena	5
Compulsory Elective Subject P03[1]	5
Energy Management	5
Computational Fluid Dynamics	5
Thermodynamics Solution	5

Semester 2	ECTS
Engineering Acoustics 2	5
Two-Phase Flow	5
Heat Exchangers	5
Experimental Modelling in Power and Process Engineering	5
Experimental Fluid Mechanics	5
Air- Conditioning	5

YEAR 2

Semester 3	ECTS
Renewable Energy Sources	5
Cooling	5
Process Engineering	6
Mechanical Process Engineering	5
Elective General Course S01[2]	5
Elective General Course S02[2]	4

Semester 4	ECTS
Air-Conditioning and Cooling Systems	6
Elective General Course S03[2]	4
Master's Practicum	5
Master's Thesis	15

Table 4.5.5-S02b: Syllabus – **Power Engineering**

1st year

1st semester	ECTS
Mathematics 4	5
Transport Phenomena	5
Compulsory Course PO3[1]	5
Energy Management	5
Computational Fluid Dynamics	5
Thermodynamics Solution	5

2nd semester	ECTS
Technical Acoustics 2	5
Two-Phase Flow	5
Heat Exchangers	5
Experimental Modelling in EPME	5
Processes in Internal Combustion Systems	5
General Elective Course S01[2]	5

2nd year

3rd semester	ECTS
Turbo Machinery	5
Heat Generators	5
Fuels and Combustion	5
Vehicle Propulsion Systems	5
Energy Conversion Systems	5
General Elective Course S02[2]	5

4th semester	ECTS
Positive-Displacement Pumps and Compressors	6
General Elective Course S03[2]	4
Master's Practicum	5
Master's Thesis	15

Table 4.5.5-S03a: Syllabus – **Production Technologies and Systems**

YEAR 1

1st semester	ECTS
Experimental Methods	5
Technical Cybernetic	5
Random Phenomena	5
Metal Cutting	5
Nonconventional Processes	5
Elective General Course S01[1]	5

2nd semester	ECTS
Heat Treatments and Surface Modification	5
Joining and Thermal Cutting Technology	5
Production Planning and Control	5
Quality Design and Control	5
Metal Forming	5
CAM	5

YEAR 2

3rd semester	ECTS
Investment Engineering	5
Machine Tools and Devices	5
Productronic and Forming Systems	5
Metrology	5
Forming of Non-Metal Materials	5
Elective General Course S02[1]	5

4th semester	ECTS
Materials Testing	5
Elective General Course S03[1]	5
Master's Practicum	5
Master´s Thesis	15

Table 4.5.5-S03b: Syllabus – **Design of Manufacturing Systems**

YEAR 1

1st semester	ECTS
Experimental Methods	5
Technical Cybernetics	5
Random Phenomena	5
Metal Cutting	5
Unconventional Processes	5
Elective General Course S011	5

2nd semester	ECTS
Heat Treatments and Surface Modification	5
Joining and Thermal Cutting Technology	5
Production Planning and Control	5
Quality Design and Control	5
Metal Forming	5
Selected Chapters of Operational Research	5

YEAR 2

3rd semester	ECTS
Investment Engineering	5
Psychology of Work and Organisation	5
FMS	5
Assembly and Handling Systems	5
Logistics of Internal Transport	
Elective General Course S021	5

4th semester	ECTS
Production Systems	5
Elective General Course S031	5
Master's Practicum	5
Master's Thesis	15

Table 4.5.5-S04: Syllabus – **MECHATRONICS AND LASER TECHNOLOGY**

Year 1

1st semester	ECTS
Experimental Methods	5
Technical Cybernetics	5
Random Phenomena	5
Advanced Dynamics	5
Engineering Design Techniques	5
Microprocessor Control	5

2nd semester	ECTS
Mechatronic Systems	6
Continuum Mechanics	6
Computer Aided Structural Analysis	6
Laser Processing Technology	6
Discrete Control Systems	6

Year 2

3rd semester	ECTS
Sensors and Actuators	5
Mechanisms	5
Production Planning and Control	5
Distributed Systems	5
Laser Measurement Systems	5
Elective General Course S01[2]	5

4th semester	ECTS
Elective General Course S02[2]	5
Elective General Course S03[2]	5
Master's Practicum	5
Master's Thesis	15

For the seven interdisciplinary fields of specialisation, which are only offered if there is sufficient demand, the brochure provides syllabi of the same structure.