



# **ASIIN Seal & European Labels**

## **Accreditation Report**

### **Bachelor's Degree Programmes**

***Multimedia***

***Academic Study Programme in Electrical Engineering***

***Professional Study Programme in Applied Electrical Engineering***

### **Master's Degree Programmes**

***Electrical Engineering***

***Multimedia***

Provided by

**University of Ljubljana**

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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 <sup>1</sup>	Previous accreditation (issuing agency, validity)	Involved Technical Committees (TC) <sup>2</sup>
<i>Interdisciplinarni univerzitetni prvostopenjski študijski program Multimedija</i>	Academic Study Programme in Multimedia	ASIIN, EUR-ACE® Label	Nacionalna agencija Republike Slovenije za kakovost v visokem šolstvu (NAKVIS) / Slovenian Quality Assurance Agency for Higher Education (SQAA) 17.5.2012 – 16.5.2019	02
<i>Interdisciplinarni univerzitetni drugostopenjski študijski program Multimedia</i>	Postgraduate Study Programme in Multimedia	ASIIN, EUR-ACE® Label	n.a.	02
Prvostopenjski univerzitetni študijski program Elektrotehnika	Academic Study Programme in Electrical Engineering	ASIIN, EUR-ACE® Label	NAKVIS, 23.10.2008-30.09.2016	02
Drugostopenjski univerzitetni študijski program	Postgraduate Study Programme	ASIIN, EUR-ACE® Label	NAKVIS, 26.08.2010 –	02

<sup>1</sup> ASIIN Seal for degree programmes; EUR-ACE® Label: European Label for Engineering Programmes; Euro-Inf®: Label European Label for Informatics; Eurobachelor®/Euromaster® Label: European Chemistry Label

<sup>2</sup> TC: Technical Committee for the following subject areas: TC 02 – Electrical Engineering/Information Technology)

## A About the Accreditation Process

Elektrotehnika	in Electrical Engineering		30.09.2017	
Prvostopenjski visokošolski strokovni študijski program Aplikativna Elektrotehnika	Professional Study Programme in Applied Electrical Engineering	ASIIN, EUR-ACE® Label	NAKVIS, 23.10.2008-30.09.2016	02
<p><b>Date of the contract:</b> 08.12.2015</p> <p><b>Submission of the final version of the self-assessment report:</b> 26.10.2016</p> <p><b>Date of the onsite visit:</b> 2.-3.11.2016</p> <p><b>at:</b> Faculty of Electrical Engineering, University of Ljubljana</p>				
<p><b>Peer panel:</b></p> <p>Prof. Dr. Madhukar Chandra, Technical University of Chemnitz</p> <p>Prof. Dr. Hans Martin Gündner, University of Applied Sciences Esslingen</p> <p>Prof. Dr. Bettina Harriehausen-Mühlbauer, University of Applied Sciences Darmstadt</p> <p>Prof. Dr. Dieter Hogrefe, University of Göttingen</p> <p>Mr. Miha Novak Kač, COMPETO d.o.o.</p>				
<p><b>Representatives of the ASIIN headquarter:</b></p> <p>Madlen Schweiger, M.A.</p> <p>Dr. Martin Foerster</p>				
<p><b>Responsible decision-making committee:</b> Accreditation Commission for Degree Programmes</p>				
<p><b>Criteria used:</b></p> <p>European Standards and Guidelines as of 15.05.2015</p> <p>ASIIN General Criteria, as of 10.03.2015</p> <p>Subject-Specific Criteria of Technical Committee 02 – TC 02 – Electrical Engineering/Information Technology as of 09.12.2011</p>				

## B Characteristics of the Degree Programmes

a) Name	Final degree (original/English translation)	b) Areas of Specialization	c) Corresponding level of the EQF <sup>3</sup>	d) Mode of Study	e) Double/Joint Degree	f) Duration	g) Credit points/unit	h) Intake rhythm & First time of offer
<i>Multimedia</i>	dipl. inž. mm. (UN), B.Sc.	- Media technology basics: audio, video, design - Telecommunications - Digital TV production and broadcasting - Software development	Level 6	Full time	No	6 Semester	180 ECTS	Fall semester/ 1.-10.-2014
<i>Multimedia</i>	mag. inž. mm. M.Sc./Eng./	- Media technologies: audio, video, design, language; - Telecommunications; - Software development; - Computer graphics; - Management and business development, ethics	Level 7	Full time	No	4 Semester	120 ECTS	First time offer: 1.-10. 2017
<i>Academic Study Programme in Electrical Engineering</i>	Dipl. inž. el. (UN) / B.Sc.	- Control Engineering, Electronics, Power Engineering and Mechatronics, -Telecommunications	Level 6	Full time	No	6 Semester	180 ECTS	Fall semester/ 01.10.2009
<i>Professional Study Programme in Applied Electrical Engineering</i>	Dipl. inž. el. (VS) / B.Sc.	- Control Engineering, - Electronics, - Power Engineering Technology and System Automation, - Telecommunications, - Quality Engineering	Level 6	Full time	No	6 Semester	180 ECTS	Fall semester/ 01.10.2009

<sup>3</sup> EQF = The European Qualifications Framework for lifelong learning

## B Characteristics of the Degree Programmes

a) Name	Final degree (original/English translation)	b) Areas of Specialization	c) Corresponding level of the EQF <sup>3</sup>	d) Mode of Study	e) Double/Joint Degree	f) Duration	g) Credit points/unit	h) Intake rhythm & First time of offer
Postgraduate Study Programme In Electrical Engineering	Mag. inž. el. / M.Sc.	- Control Systems and Computer Engineering, - Biomedical Engineering, - Electrical Power Engineering, - Electronics, - Mechatronics, - Robotics, - Telecommunications	Level 7	Full time	No	4 Semester	120 ECTS	Fall semester/ 01.10.2012

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

“The Interdisciplinary academic study programme (1st cycle) in Multimedia is composed of subjects from three domains: 1) Fundamentals, which covers mathematical and technology (electrotechnical/computers) basics, necessary for understanding other domains; 2) Technology, which covers telecommunications topics, information/software technology, digital signal processing, digital TV production and broadcasting and 3) “Soft skills”, covering design basics, societal aspects of ICT, project work and management, etc. In this way the multimedia engineers will have knowledge of mostly engineering aspects of multimedia with additional soft skills necessary for interdisciplinary projects in the field of multimedia.”

The Homepage also offers the following description **objectives** and **learning outcomes (intended qualifications profile)**:

**The basic goals of the programme are:**

- Ensure quality knowledge which of which multimedia consists
- Provide excellent basics for the 2nd cycle of Multimedia or related studies.
- Providing good employability of the graduates and effective integration on the workplace
- Raising innovative employees for the new industries, as well as enabling them to constantly track the latest developments
- Allowing transitioning between related study programs, while keeping up with the European educational standards
- Establishing a foundation and encouragement for proceeding studies in the context of lifelong learning

### Basic skills you will gain:

- Possibility of understanding and solving problems in the area of multimedia
- Skill of critical thinking based on analysis
- Ability to research and plan accordingly
- Professional, environmental and social responsibility
- Ability to communicate professionally
- Ability to optimally use Information and Communication Technologies
- Ability of independent tracking the newest innovations and gaining new skills
- Possibility of teamwork with experts from the technological and non-technological area.

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

“The interdisciplinary postgraduate study programme (2nd cycle) in Multimedia is a natural continuation of the 1st cycle Multimedia programme, providing a deeper and more specialized insight into the field. It follows the logic of an interdisciplinary programme, designed to give students knowledge and skills from two complementing fields: new technologies in the field of multimedia, and methods, algorithms and programming skills, necessary for designing, implementing and maintaining modern multimedia systems. At the same time, the programme is structured so that through a choice of elective components in the programme each individual study track will profile the student into a specialist in a field that has been identified as central in the multimedia career spectrum and job market.”

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

### The basic objectives of the programme are:

- to offer high-quality knowledge in electrical engineering,
- to provide an excellent foundation for 2nd cycle study not only in electrical engineering but in any technical discipline,
- to enable efficient entry to the labour market through employment and independent tracking of the most recent achievements,
- to provide a good basis and incentive for further autonomous study within the framework of lifelong learning,

## B Characteristics of the Degree Programmes

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- to enable mobility between related and other study programmes and to ensure Europe-wide comparability of the achieved education.

### General competences obtained through the programme:

- the ability to define, understand and creatively solve problems in the field of electrical engineering and in other fields,
- critical thinking on the basis of analysis and synthesis,
- professional, environmental and social responsibility,
- active professional written and oral communication,
- optimal use of ICT and its advancement,
- independent tracking of the most recent achievements and acquisition of new knowledge,
- teamwork with experts from various fields

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

### The basic objectives of the programme are:

- to offer high-quality applied knowledge in the field of electrical engineering,
- to enable rapid and efficient entry to the labour market through employment,
- to provide a basis for further autonomous tracking of developments in the profession within the framework of lifelong learning,
- to provide a sound foundation for 2nd cycle study in electrical engineering,
- to enable mobility between related study programmes and to ensure Europe-wide comparability of the achieved education

### General competences obtained through the programme:

- the ability to define, understand and solve problems in the field of electrical engineering,
- critical evaluation of concrete solutions,
- professional, environmental and social responsibility,
- professional written and oral communication,



## **B Characteristics of the Degree Programmes**

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- use of ICT,
- independent tracking of developments in the profession,
- teamwork with experts from related fields

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

**The basic objectives of the programme are:**

- to offer top-notch professional knowledge in electrical engineering,
- to promote creativity and critical thinking in exploring new solutions,
- to enable efficient involvement in R&D efforts through employment and innovative exploration of new solutions,
- to provide an excellent foundation for 3rd cycle study in electrical engineering or any other technical discipline,
- to convince students of the necessity of further autonomous study within the framework of lifelong learning,
- to enable mobility between related study programmes and to ensure Europe-wide comparability of the achieved education

**General competences obtained through the programme:**

- creative scientific research and development work in the field of electrical engineering and in other fields,
- independent tracking and critical evaluation of the most recent achievements in electrical engineering,
- active written and oral communication both at a high professional level as well as at a non-technical level, depending on the target audience,
- efficient use of ICT and its advancement,
- professional, environmental and social responsibility,
- teamwork with experts from various fields

## C Peer Report for the ASIIN Seal<sup>4</sup>

### 1. The Degree Programme: Concept, content & implementation

<b>Criterion 1.1 Objectives and learning outcomes of a degree programme (intended qualifications profile)</b>
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**Evidence:**

- Self-Assessment Report (SAR): Objectives matrices for each respective study programme
- Descriptions of objectives and competences on the faculty homepage, except for the Masters programme Multimedia which only starts in 2017 (accessed 7.11.2016):
  - Ba Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/electrical engineering/presentation/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/electrical_engineering/presentation/)
  - Ba Applied Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle professional study programme/applied electrical engineering/presentation/](http://www.fe.uni-lj.si/en/education/1st_cycle_professional_study_programme/applied_electrical_engineering/presentation/)
  - Ma Electrical Engineering: [http://www.fe.uni-lj.si/en/education/2nd cycle postgraduate study programme/electrical engineering msc/presentation/](http://www.fe.uni-lj.si/en/education/2nd_cycle_postgraduate_study_programme/electrical_engineering_msc/presentation/)
  - Ba Multimedia: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/multimedia/presentation/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/multimedia/presentation/)

**Preliminary assessment and analysis of the peers:**

The peers referred to the *Subject-Specific Criteria (SSC)* of the Technical Committee for Electrical Engineering and Information Technology as a basis for judging whether the intended learning outcomes of the three Bachelor and two Master programmes correspond to the learning outcomes of the Technical Committee. The auditors examined the areas of

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<sup>4</sup> 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.

competence as set forth by the SSC for degree programmes and came to the following conclusions:

The learning outcomes of all study programmes under review defined by the HEI are rather generic and not outcome-oriented. The peers agreed that it is not sufficient to describe competences in superficial terms such as “the ability to define, understand and creatively solve problems in the field of electrical engineering and in other fields” or the “Possibility of understanding and solving problems in the area of multimedia”. Instead more concrete achievable skills such as “efficient use of ICT and its advancement” or “to enable efficient involvement in R&D efforts through employment and innovative exploration of new solutions” point into the right direction. Further input on how to formulate the learning outcomes in an outcome-oriented taxonomy can be gained from the list of *Subject-Specific Criteria (SSC)* provided by the Technical Committee for Electrical Engineering. Furthermore, the description of the learning outcomes must make possible a clear distinction between the competences achieved in the respective Bachelor programmes and additionally in the Master programmes. The peers considered that at the moment a clear differentiation between the described learning outcomes of the Academic and Professional Bachelor of Electrical Engineering is not possible, the same being valid for the Master’s programme. As for example the described competences “optimal use of ICT and its advancement” (Academic Bachelor), “use of ICT” (Professional Bachelor) and “efficient use of ICT and its advancement” (Master) do not allow an assessment of distinguishable programme-specific characteristics.

It is absolutely necessary that the educational objectives describe the academic, subject-specific and professional classification of the qualifications gained in the degree programmes. Eventually, it must be made sure that the revised qualification objectives are accessible for all relevant stakeholders and it must be ensured that the stakeholders can refer to them. After all, the peers came to the conclusion that the given problem is not one of missing content but merely of description. In the discussion with the programme coordinators the qualification profiles became sufficiently clear. It is consequently expected that they will perfectly fit the *Subject Specific Criteria* of ASIIN in all five degree programmes under review. This was especially mirrored in the content descriptions of the modules discussed under criterion 1.3. In addition, the academic level of the programmes can be clearly deduced, being in full compliance with the standards of the EQF levels 6 and 7 for Bachelor’s and Master’s graduates respectively.

Furthermore, the University applied for the EUR-ACE® (European Accredited Engineer) Label<sup>5</sup> for all degree programmes under review. The EUR-ACE® Label is a quality certificate

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<sup>5</sup> <http://www.enaee.eu/eur-ace-system/>

for engineering degree programmes and is recognized Europe-wide. During the accreditation process, the reviewers verified whether the engineering degree programme complies with the criteria fixed in the EUR-ACE Framework Standards. The *Subject-Specific Criteria (SSC)* are closely linked to the EUR-ACE Framework Standards; consequently, the analysis of the Subject-Specific Criteria encompasses the EUR-ACE Framework Standards. In consequence of the discussion with the programme coordinators the peers confirmed that after the reformulation of the learning outcomes the EUR-ACE Framework Standards for the all five degree programmes will be met.

<b>Criterion 1.2 Name of the degree programme</b>
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**Evidence:**

- Self-assessment report
- Homepage of the faculty of Electrical Engineering (accessed 15.11.2016):  
<http://www.fe.uni-lj.si/en/>

**Preliminary assessment and analysis of the peers:**

The panel considered the names of the study programmes as absolutely adequate reflecting the respective aims and learning outcomes.

The peers confirmed that all degree programme titles reflect the intended aims and learning outcomes. Main course language is Slovene although some courses are offered in English as well for incoming students.

<b>Criterion 1.3 Curriculum</b>
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**Evidence:**

- Module Handbooks and study plans in the SAR
  - Objectives-Course Matrices for all programmes in the SAR
  - Discussions with management, staff, students, graduates and employers during on-site visit
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**Preliminary assessment and analysis of the peers:**

The analysis of the curriculum by the panel was based on the Self-Assessment-Report and the Objectives-Course-Matrices provided by the faculty. A course syllabus has also been provided alongside the respective module handbooks.

Despite the fact, that detailed module descriptions as well as curricula for all study programmes have been accessible to the peers as part of the SAR there are no comparable information available on the faculty homepage. There are only offered rudimentary descriptions of the respective modules as part of an alphabetical list and no curricula at all. The available link on the programmes' curricula on the website does not yet have any content. The only exception is the Bachelor Multimedia programme that provides a detailed curriculum for all persons interested on a separate website. The peers understood that the administration for the Bachelor Multimedia programme lies with the faculty of Electrical Engineering while the administration of the Master's programme lies with the faculty of Computer and Information Sciences. However, it must be made sure that all information regarding the interdisciplinary Multimedia programmes is available at all time or at least the link for the external Multimedia Homepage must be present on both faculties' websites for reasons of transparency. For the same reason the panel considered it generally important that external stakeholders such as future students, exchange students, and employers would also be able to find details about the programme curricula at their disposal. (Compare also criterion 5.3)

As outlined under criterion 1.1 the *Subject-Specific Criteria (SSC)* of the ASIIN Technical Committee for Electrical Engineering and Information Technology could hardly be matched as they were described rather generic and not detailed enough, nevertheless, considering the described module contents and the respective module-objective matrices the peers were convinced that they are in accordance with the SSC and consequently impart the intended learning outcome to meet the ASIIN criteria. Hence, they came to the following conclusions:

For all three Bachelor programmes the peers confirmed, that basic *knowledge and understanding* of mathematics, natural sciences and engineering is acquired in courses such as "Fundamentals of Mathematical analysis", "Technical Fundamentals of Multimedia", "Mathematics I-IV" or "Fundamentals of Electrical Engineering I-II".

Competences in the field of *engineering analysis* shall be gained by the students in courses like "Programming and Algorithms", "Introduction to Computer Programming", "Communication Systems", "Measurements", "Atomics and Optics" or "Modelling and Simulation". Relevant aspects of *engineering design* which should provide students with the ability to use in their design work elements like modelling, simulation and tests are imparted in

courses such as “Computer Simulation”, “Web Programming”, “Electrical Machine Modeling”, “Electrodynamics”, “Embedded Systems in Automatics”, or “Analog Electronic Circuits”.

The panel further acknowledged that skills in engineering *practice and product development* were especially emphasized in the study programmes under review. Laboratory work is included in a great variety of courses obligatory to all students, industry and staff offer ideas for practical projects and credits can be gained for laboratory work. In the Bachelor programmes in Electrical Engineering more specialized skills in design and engineering practice are generally transmitted in different study options. In the third year Students select among the four study options “Control Engineering”, “Electronics”, “Power Engineering and Mechatronics” and “Telecommunications” while no time is reserved for the preparation of a Bachelor thesis (see point 3). The Applied Electrical Engineering programme offers five programme options (“Control Engineering”, “Electronics”, “Power Engineering Technology and System Automation”, “Telecommunications” and “Quality Engineering”) already after the first year. Additionally, a work practice (internship) worth 20 credit points and lasting 13 weeks is included in the sixth semester. For all three Bachelor programmes general practical competences are developed in courses like “Studio and multimedia production technology”, “Communications security and content protection”, “High Voltage Engineering”, “Electrical Power Systems”, “Robotics and Manufacturing Processes” or “Electrical Energy Production”. Likewise transferable skills are taught as part of many modules and courses such as “Project Management, Innovation and Teamwork”, “Control of Quality and Reliability” or “Organization and Management”. Additionally, courses specialized on transferable skills as for example “Business Intelligence” or “English” are also offered as elective courses. Students are further recommended to attend courses at other faculties, especially on legal aspects and ethics.

Contrary to the Bachelor programme Multimedia that chiefly consists of compulsory courses the peers learned that the Master of Multimedia programme is to a high degree characterized by elective courses designed to give students knowledge and skills from two complementing fields: new technologies in the field of multimedia, and methods, algorithms and programming skills, necessary for designing, implementing and maintaining modern multimedia systems. The programme is an interdisciplinary one but despite the fact that the Master is chiefly administered by the faculty of Computer and Information Sciences, especially considering the EUR-ACE label, engineering contents are explicitly relevant in it. Aspects of *Engineering design and practice* are particularly represented in second-year courses such as “User Experience and User Interfaces Design”, “Cryptography and Computer Security” or “Sensor Systems and Multimedia”.

Transferable skills are similarly conveyed as part of many electives. Nonetheless, the peers questioned if knowledge in legal and ethical issues which are of such importance today is sufficiently incorporated in the curriculum. The programme coordinators explained that

these topics are represented in the course “Information Security and Privacy” which was acknowledged by the peers who suggested that such courses might better be a mandatory subject for all students.

The Master of Electrical Engineering programme contains seven study options: “Control Systems and Computer Engineering”, “Biomedical Engineering”, “Electrical Power Engineering”, “Electronics”, “Mechatronics”, “Robotics” and “Telecommunications”. Despite an *in-depth knowledge* in mathematics and electrical engineering as well as *analysis* on which all courses recur, competences in *Engineering design and practice* are taught in different weighting in the respective specialized electives, exemplary courses being “Automated and Virtual Measurement Systems” “Analogue and Digital Integrated Circuits and Systems”, “Neurocybernetics”, “Robot Kinematics and Dynamics” or “Antennas and Wave Propagation”. In Electrical Engineering the existing module handbook did not reveal whether some burning aspects and topics were included in the curriculum, e.g. sustainability (regenerative energies, smart grids, recyclable materials) or Industry 4.0 (Robotics, Mechatronics, IoT). However, the teaching staff was able to convincingly demonstrate that most of these aspects do already form part of the curriculum while “older” topics are being squeezed. The auditors recommend to include these aspects into the module descriptions (see point 5.1).

In conclusion, the peers expressed their general approval of the programmes’ curricula and showed themselves convinced, that they are adequate in order to achieve the intended learning outcome.

<b>Criterion 1.4 Admission requirements</b>
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**Evidence:**

- SAR
- Admission requirements on the website of the faculty (accessed 15.11.2016):
  - Ba Electrical Engineering: <http://www.fe.uni-lj.si/en/education/1st-cycle-academic-study-programme/electrical-engineering/access-requirements/>
  - Ba Applied Electrical Engineering: <http://www.fe.uni-lj.si/en/education/1st-cycle-professional-study-programme/applied-electrical-engineering/access-requirements/>
  - Ma Electrical Engineering: <http://www.fe.uni-lj.si/en/education/2nd-cycle-postgraduate-study-programme/electrical-engineering-msc/access-requirements/>

- Ba Multimedia: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/multimedia/access requirements/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/multimedia/access_requirements/)
- Discussions with management, staff and students during onsite visit

**Preliminary assessment and analysis of the peers:**

Information on the Admission requirements for all study programmes is available on the faculty website. Admission to all three Bachelor programmes is allowed to all individuals who have successfully completed general matura. Any deficiencies in necessary subjects such as mathematics may be compensated through summer courses offered to students before the start of the first semester.

For the Master of Multimedia programme which is only to start in October 2017 admission requirements are not yet openly public. Admission will require a completed first cycle study of multimedia, computer science, electrical engineering, natural sciences, engineering, or studies in other fields of natural science and technology (mathematics, physics, chemistry and chemical technology, mechanical engineering, civil engineering). Applicants with other Bachelor degrees have to pass examinations from the first-cycle programme in “Programming 1, Programming 2, Introduction to Multimedia Systems and Communication Systems” prior to enrolment. The peers are sufficiently convinced of the adequacy of these regulations and that in time all necessary admission requirements will also be publicly available.

For the Master Electrical Engineering the website informs that access is granted to all graduates of a first cycle undergraduate study programme awarding at least 180 ECTS in the field of electrical engineering or related technical/natural/mathematical sciences. Graduates from any other Bachelor programme may be admitted if they have completed the study components essential for further study to the extent of 46 ECTS: Mathematics I, Mathematics II, Fundamentals of Electrical Engineering I, Fundamentals of Electrical Engineering II, Programming Fundamentals and Measurements, prior to enrolment. Therefore, an overlap in contents during the first year of the Master programme will be limited to a minimum. In the case of limited enrolment, candidates will be selected on the basis of the results of a selection exam covering topics from the field of electrical engineering.

The peers were to a certain degree unsure if the admission exam will be obligatory to all applicants, including those with a first cycle degree in Electrical Engineering, or if the information on the website is correct, according to which exams are only held in case of exceeding numbers of applicants. During the discussion with the teaching staff and programme coordinators it was understood, that an exam for all applicants is mandatory ensuring an



equal knowledge level in the fields of Mathematics and Electrical Engineering. A clarification on this point would be welcome. However, the peers learned that the admission policy is well-known to all stakeholders and suitable for the operational sequence.

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

From the statement of the HEI the peers learned that a careful reconsideration and reformulation of all the learning outcomes is planned in order to make them compliant with the standards required. However, until this task is fulfilled the peers have to stick with their original requirement.

Regarding the publication of curricula and module descriptions on the faculty websites the peers noted that the HEI has very much improved the presentation following their recommendations. Full curricula and course descriptions for all programmes (with exception of the Master programme in Multimedia which has not yet started) are now easily accessible in English to all stakeholders. Consequently the peers see this requirement as completely fulfilled.

Concerning the admission policy for the Master programme in Electrical Engineering the peers acknowledged the clarification by the HEI that candidates are selected on the basis of the results of a test (selection exam) covering topics from the field of electrical engineering. This selection exam is obligatory for all the eligible applicants (regardless of their 1st cycle study programme or their grades) and only the students ranked above the number of available places are entitled to enrol.

## 2. The degree programme: structures, methods and implementation

### Criterion 2.1 Structure and modules

**Evidence:**

- SAR: Module Handbooks and study plans lecture syllabus
- Module descriptions on the website of the faculty of Electrical Engineering (accessed 08.11.2016):
  - Ba Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st\\_cycle\\_academic\\_study\\_programme/electrical\\_engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/electrical_engineering/subjects/)

- Ba Applied Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle professional study programme/applied electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st%20cycle%20professional%20study%20programme/applied%20electrical%20engineering/subjects/)
- Ma Electrical Engineering: [http://www.fe.uni-lj.si/en/education/2nd cycle postgraduate study programme/electrical engineering msc/subjects/](http://www.fe.uni-lj.si/en/education/2nd%20cycle%20postgraduate%20study%20programme/electrical%20engineering%20msc/subjects/)
- Ba Multimedia: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/multimedia/subjects/](http://www.fe.uni-lj.si/en/education/1st%20cycle%20academic%20study%20programme/multimedia/subjects/)
- Website of University of Ljubljana regarding international co-operation: [https://www.uni-lj.si/international cooperation and exchange/](https://www.uni-lj.si/international%20cooperation%20and%20exchange/) (accessed 10.11.2016)
- Discussions with management, staff and students during onsite visit

**Preliminary assessment and analysis of the peers:**

All study programmes under review are divided into modules which comprise a sum of teaching and learning. The panel found the structure of the modules in general to be adequate and manageable for all stakeholders.

For all programmes the peers learned that a great variety of elective study options is offered, most explicit in the Master programmes. The Bachelor of Multimedia offers elective courses in the last three semesters while the Master of Multimedia consists in the first year of 50% electives and in the third semester to a 100% and the fourth semester is nearly entirely reserved for the completion of the Master's thesis. In the Bachelor programmes of Electrical Engineering students are offered four (academic) or five (applied) study programme options (see criterion 1.3). An internship is integrated into the applied Electrical Engineering programme in the third year at a value of 20 ECTS. For the internship a system of joint supervision has been introduced. Students are partly supervised by a member of the faculty's teaching staff and partly by a representative of the company. Thus it is envisaged to develop practical work related themes for the Bachelor thesis. The Master of Electrical Engineering consists of seven study options in the first three semesters while the fourth semester is dedicated to producing the Master's thesis. However, the panel appreciated the fact that the study options are not clearly separated tracks but its modules can be easily interchanged by the students in order to achieve maximum flexibility. The peers recognized that in all study programmes it is the aim to allow for an individual study focus while at the same time meeting the general necessary learning outcomes. The modularized structure thus described adequately corresponds to this intention.

Working practice in form of laboratory work is part of many modules in all programmes and cooperation with industrial partners in the development of assignments and theses allows for a vivid experience of practical work issues. Conclusively and based on the analysis of the curriculum and the module descriptions, the peers confirmed that the module objectives and the respective content help to reach both the qualification level and the overall intended learning outcomes of the respective programmes.

International mobility is possible through the university's cooperation with over 500 universities in Europe and the International student exchange coordinator of the faculty is easily accessible for all students. At the same time the website of the University informs about scholarships, partner institutions on departmental level, teaching offers for incoming students and International Credit Mobility.

### Criterion 2.2 Work load and credits

#### Evidence:

- SAR: Module Handbook
- Module descriptions (accessed 15.11.2016):
  - Ba Multimedia: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/multimedia/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/multimedia/subjects/)
  - Ba Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/electrical_engineering/subjects/)
  - Ba Applied Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle professional study programme/applied electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_professional_study_programme/applied_electrical_engineering/subjects/)
  - Ma Electrical Engineering: [http://www.fe.uni-lj.si/en/education/2nd cycle postgraduate study programme/electrical engineering msc/subjects/](http://www.fe.uni-lj.si/en/education/2nd_cycle_postgraduate_study_programme/electrical_engineering_msc/subjects/)

#### Preliminary assessment and analysis of the peers:

The student workload in the Multimedia programmes is generally calculated at 30 hours per credit point and a value of 60 ECTS per year. Approximately 40% of the hours are contact hours in forms of lectures and tutorials/laboratory practice, the remaining hours being intended for the students' self-study and exam-preparation. For the Electrical Engineering programmes the workload is at 25 hours per credit point and 1500 work hours per study

year. The hours are equally divided between contact hours and self-study. According to the students the calculation of the workload is generally appropriate and the courses of all study programmes are well-balanced between contact hours and self-study. An excess of study duration due to any miscalculation of the workload could not be identified. A survey of the workload among other aspects is being conducted at the end of each semester with voluntary participation of the students. Additionally, if any overload occurs regularly the students feel encouraged to approach the teachers directly and issues are being discussed. Consequently, the peers got the impression that the workload calculation for all study programmes under review is absolutely adequate and contribute to the successful implementation of the study curriculum.

The relevant information on credits, contact hours and self-study was made available to the peers through the module descriptions forming part of the SAR. However, this information is not openly published on the website for all stakeholders. If students are informed about the distribution of workload in the respective modules via the Intranet STUDIS this was not presented to the auditors. In general, it is recommended that all data considering workload and credits are clearly visible to the public (see criterion 5.1).

### Criterion 2.3 Teaching methodology

#### Evidence:

- SAR
- Module descriptions (accessed 15.11.2016):
  - Ba Multimedia: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/multimedia/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/multimedia/subjects/)
  - Ba Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/electrical_engineering/subjects/)
  - Ba Applied Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle professional study programme/applied electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_professional_study_programme/applied_electrical_engineering/subjects/)
  - Ma Electrical Engineering: [http://www.fe.uni-lj.si/en/education/2nd cycle postgraduate study programme/electrical engineering msc/subjects/](http://www.fe.uni-lj.si/en/education/2nd_cycle_postgraduate_study_programme/electrical_engineering_msc/subjects/)
- Discussions with management, staff and students during onsite visit

**Preliminary assessment and analysis of the peers:**

The module descriptions indicate clearly what parts of the contact hours are performed in which form, distinguishing between lectures, seminar, tutorials and laboratory. The descriptions also enlist the variety of teaching methods and examinations being for example homework assignments, oral presentations, group work, etc.

To further enhance the teaching methodology the faculty for Electrical Engineering has recently set up an online Intranet-platform that will provide the teaching staff with applications according to their individual course necessities, including PowerPoint Presentations, videos, etc. The peers were thus demonstrated how the available eContent is growing slowly but steadily.

The panel agreed that a significant part of the study programmes consists of the practical work experience in laboratories which is reflected by the Applied approach proclaimed by the faculty. The teaching methodology in this regard was discussed in detail. The peers learned that, while each teacher has an individual approach to laboratory work didactics, students of the first two years of all Bachelor programmes are primarily guided through the experiments, approximately two thirds of an hour being spent on the theoretical introduction. Conducted experiments consist mainly of prearranged steps while students are continuously prepared for more independent proceedings that are mostly reserved for third year Bachelor and Master students. The peers understood that such a proceeding may be helpful for the development of basic knowledge required in later stages of the study programmes; however, the peers recommended to require the students to independently find a solution to a practical problem as well as report about it even at first-semester level.

<b>Criterion 2.4 Support and assistance</b>
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**Evidence:**

- Information about student services available online: [http://www.fe.uni-lj.si/en/the\\_faculty/about\\_faculty/organisation/](http://www.fe.uni-lj.si/en/the_faculty/about_faculty/organisation/) (accessed 08.11.2016)
- SAR
- Discussions with staff and students during onsite visit

**Preliminary assessment and analysis of the peers:**

The peers gained the impression, that in general there is an adequate provision of support and assistance for all study programmes. The students highlighted in the discussion easy and informal accessibility to all teaching staff, contact hours are well-known, and those

responsible for student affairs and International Student Exchange as well as the representatives of the Student Council can be approached at all times.

After the summer preparatory courses in Mathematics (see criterion 1.4), first-semester students have access to assistance of tutors, advanced students that are guided by a professor and awarded 3 credit points for their work. These tutors may be approached online at all times and are also available for personal meetings. Currently, the faculty offers the service of 20 tutors whose help is mainly required at the start of each semester and during exam periods.

In sum, the peers confirmed that the advice and guidance (both technical and general) on offer 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:**

Thanks to the comment of the HEI the peers understood that the complete and relevant information on credits, contact hours, and self-study being part of the course descriptions was published on Slovenian website only, English translations being only available for those courses open to international students. Since in the meantime not only the curricula but also a full translation of the module descriptions has been added to the English website the peers considered this criterion as completely fulfilled.

With regards to the peers' recommendation to require the students to independently find solutions to practical problems and report on it, even at the first-semester level the peers welcome the HEI's notification that it is tried to implement this kind of practice in the study programmes. Since this is admitted to take some time and additional funds it could not have been achieved by now and the peers keep up their former recommendation which may be revised during a re-accreditation.

### 3. Exams: System, concept and organisation

<b>Criterion 3 Exams: System, concept and organisation</b>
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**Evidence:**

- Module descriptions (accessed 15.11.2016):
  - Ba Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st\\_cycle\\_academic\\_study\\_programme/multimedia/subjects/](http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/multimedia/subjects/)

- Ba Applied Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle professional study programme/applied electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st%20cycle%20professional%20study%20programme/applied%20electrical%20engineering/subjects/)
- Ma Electrical Engineering: [http://www.fe.uni-lj.si/en/education/2nd cycle postgraduate study programme/electrical engineering msc/subjects/](http://www.fe.uni-lj.si/en/education/2nd%20cycle%20postgraduate%20study%20programme/electrical%20engineering%20msc/subjects/)
- Examination rules of the faculty of Electrical Engineering: [http://www.fe.uni-lj.si/en/education/students office/rules and forms/examination rules/](http://www.fe.uni-lj.si/en/education/students%20office/rules%20and%20forms/examination%20rules/) (accessed 08.11.2016)
- “Guidelines for preparation, writing, and defence of the master’s theses 2nd cycle study programmes of the Faculty of Computer and Information Science of the University of Ljubljana”: [http://www.fri.uni-lj.si/Static/upload/file/bnavodila mag ENG sep14.pdf](http://www.fri.uni-lj.si/Static/upload/file/bnavodila_mag_ENG_sep14.pdf) (accessed 08.11.2016)
- „Rules on the Master's Thesis of 2nd Cycle Studies at the Faculty of Computer and Information Science, University of Ljubljana“ published on the website: [http://www.fri.uni-lj.si/en/education/masters/forms and procedure/](http://www.fri.uni-lj.si/en/education/masters/forms%20and%20procedure/) (accessed 08.11.2016)

### **Preliminary assessment and analysis of the peers:**

The examination practice in place is clearly and transparently described in the syllabi, including the examination forms, the weighting of the examination parts as well as the calculation of the final grade. The auditors learned that in all study programmes the teaching staff of each module decides which course exams have to be passed during the semester in order to register for the final course exam which may be oral or written. Each exam has to be taken according to the Examination rules of the Faculty of Electrical Engineering and the Examination rules of the Faculty of Computer and Information Sciences. Exam announcements are made in advance in the description of the courses accessible to all students online as well as on the Intranet-platform STUDIS. Possible forms of exams are laboratory works, practical tasks, seminar works or reports. The peers appreciated this continuous review of the students’ progresses. The final course exams are held in a four week period at the end of the semester. During the first week there is one written exam every day with the possibility to skip them to the third week in order to alleviate exam pressure on the students. According to the same structure oral exams are held in the second and fourth week. In discussion with the student the peers got the impression that system, concept and organization as well as the overall workload of the exams is adequate and that the four-week-exam-cycle leaves sufficient space to avoid an overload in the number of weekly exams.

The panel was informed that, due to Slovenian legislation and the statute of the university, failed exams may be repeated up to six times, although only the first three attempts are free of charge. The peers brought into consideration that this high number of re-examinations appears to needlessly prolong the duration of studies and is not in line with common European practice of usually two or three repetitions. Therefore, they recommend reducing the number of possible re-examinations.

The peers learned that the Bachelor of Multimedia comprises a Bachelor project valued at 6 ECTS credits while the Bachelor thesis of the Applied Electrical Engineering programme is awarded 10 ECTS credits. Given the fact that up to now no Bachelor theses have been written in the Multimedia programme the peers cannot finally assess whether these projects correspond to the international standards on scientific research work at Bachelor's level in terms of subject, depth of study and volume. However, the peers wondered if both projects can be assessed on an equal quality level. They would like to know if there is an explanation for the diverging value in ECTS-credits while international standards are being observed.

The panel further noticed that the Bachelor of Electrical Engineering does not yet include any Bachelor thesis. This was explained by the coordinators with the historical reason that originally all students were supposed to continue their studies on a second cycle level. Notwithstanding, the auditors made clear that all programmes must encompass a Bachelor thesis or a capstone project comparable to international standards. It will be absolutely necessary to include this in the respective curriculum. A guideline for such a project will be demanded as well as a module description corresponding to a course in which context the thesis will be prepared. The same is valid for the Bachelor of Multimedia programme in which no theses have yet been written.

The Master theses evaluated for Electrical Engineering were deemed adequate in quality and volume valued at 30 ECTS credits. Since the master programme in Multimedia has not yet started there were no theses to evaluate. However, the "Guidelines for preparation, writing, and defence of the master's theses" and the "Rules on the Master's theses" provided the peers with a clear impression of the intended projects and to convinced them of the adequacy of the Master's projects of both programmes.

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

Regarding the difference of credits awarded to the Bachelor diploma thesis in Multimedia and Applied Electrical Engineering the peers understood the HEI's explanation that the thesis in Applied Electrical Engineering is usually based on the work experience of the three months work practice. Since such a work practice is not included in the other programme the difference in credits seemed to be justified.



The peers appreciate the HEI's endeavours to introduce a Bachelor thesis in the Electrical Engineering programme to which goal some activities have already been initiated. It is understood that this task will require more time in order to implement the necessary structural changes. Therefore, the requirement is as yet not fulfilled.

## 4. Resources

### Criterion 4.1 Staff

**Evidence:**

- SAR: Personnel Handbooks of the Faculty of Electrical Engineering and Computer and Information Science
- Discussions with staff and students during onsite visit

**Preliminary assessment and analysis of the peers:**

The Faculties of Electrical Engineering and Computer Sciences provided the auditors with respective personnel handbooks listing the teaching staff, research activities, CVs, specialized subjects and industry co-operations. From these documents as well as from the discussions during the onsite visit the peers understood that sufficient staff is available to perform the necessary teaching while at the same time securing a continuous research effort in order to keep up with international research developments.

100% regular workload for professors includes six teaching hours, for assistant professors 10 hours weekly. Taking into account the preparation of classes, etc. this leaves a minimum of 20 hours per week for individual research. The panel appreciated this positive research environment which allows the professors to integrate the students in their projects and also to further enhance their co-operations with the local industry.

### Criterion 4.2 Staff development

**Evidence:**

- SAR
- Discussions with staff members during onsite visit

**Preliminary assessment and analysis of the peers:**

The review team understood that at the University of Ljubljana every staff member can apply for free courses on didactics/language skills/etc. and is strongly encouraged to participate. Several of the staff members had already participated in such programs and showed themselves content with the offers.

Sabbaticals are generally possible every five years although the peers got the impression that a clearly defined regulating process is lacking. Furthermore, staff members willing to go on a sabbatical have to procure an adequate replacement and secure the necessary funding. These limitations severely reduce the staff's options for sabbaticals. Likewise staff members may reduce their teaching load at any time if they present and fund a replacement. Despite these limitations the staff members emphasized that a working model has been established. Professors usually step in for their colleagues in case of their absence.

<b>Criterion 4.3 Funds and equipment</b>
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**Evidence:**

- SAR
- Discussions with staff and students during onsite visit

**Preliminary assessment and analysis of the peers:**

Teaching at the faculties of Electrical Engineering and Computer Sciences and Information Sciences is largely financed by governmental funds. However, the peers learned during their onsite visit that by now up to 54% of the faculties' total funds are research-based. These funds result from research projects of the Slovenian research agency, EU projects and contracts with industry. In order to maintain their standards in teaching the faculties subsidize the government's budget from their own research funds. Nevertheless, the auditors understood that the faculties' funding is adequately secured for the timeframe of the accreditation.

During their visit the peers had a good impression of the laboratory infrastructure and its usage. Work places as well as lecture rooms are sufficiently available for the number of students and although some of the equipments are not completely up to date they are perfectly appropriate for the teaching necessities. All classrooms and facilities are covered

with wired and wireless network, notebooks and computers are available although the students voiced some criticism regarding the sufficiency of software certificates for private computers.

The high number of research projects and the funds involved were very much appreciated by the peers. Co-operations with the industry, international as well as national, and international universities allow for a profound involvement of (mostly Master) students. At the faculty of Computer Sciences students are usually included in the research projects of the advisor of their thesis, open questions resulting from research projects are exposed in lectures for interested students to follow them up in their laboratory work. An active participation in the international research community is supported by the University with only 605 Euro annually for every professor and 208.50 Euro for each assistant. This number is considered insufficient and largely supplemented by private research funds.

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

Regarding the aspect of sabbaticals the peers accepted the version of the HEI that the procedures of a sabbatical are clearly defined and communicated. According to the HEI current difficulties are chiefly the result of lack of funding, not of missing transparency or regulation.

## 5. Transparency and documentation

<b>Criterion 5.1 Module descriptions</b>
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**Evidence:**

- SAR: Module handbooks
- Module descriptions (accessed 15.11.2016):
  - Ba Multimedia: <http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/multimedia/subjects/>
  - Ba Electrical Engineering: <http://www.fe.uni-lj.si/en/education/1st cycle academic study programme/electrical engineering/subjects/>

- Ba Applied Electrical Engineering: [http://www.fe.uni-lj.si/en/education/1st cycle professional study programme/applied electrical engineering/subjects/](http://www.fe.uni-lj.si/en/education/1st%20cycle%20professional%20study%20programme/applied%20electrical%20engineering/subjects/)
- Ma Electrical Engineering: [http://www.fe.uni-lj.si/en/education/2nd cycle postgraduate study programme/electrical engineering msc/subjects/](http://www.fe.uni-lj.si/en/education/2nd%20cycle%20postgraduate%20study%20programme/electrical%20engineering%20msc/subjects/)

**Preliminary assessment and analysis of the peers:**

For the assessment of the module descriptions the peers were provided with detailed module handbooks for all study programmes which include the module identification code, the persons responsible, detailed account of the division of work load, credit points, learning outcomes, admission and examination requirements, the forms of assessment and information on the calculation of the module mark, as well as recommended literature. After going through the documents the auditors would appreciate if the descriptions could be further specified regarding some of the modules' contents (see criterion 1.3). Concerning the Electrical Engineering programmes the professors were able to convincingly demonstrate that aspects of modern research in fields such as sustainability (regenerative energies, smart grids, recyclable materials) or Industry 4.0 (Robotics, Mechatronics, IoT) are part of the modules while "older" topics are being squeezed in order to stay up to date. The faculties demand on a regular basis all lecturers to go through their course contents to check if modern developments have to be integrated; sustainability and interdisciplinary projects are being especially demanded for. However, they are not explicitly mentioned in the module descriptions and should be made more clearly visible. In addition, the auditors would also welcome a more detailed representation of the laboratory works that form part of the modules and indicate the CAD tools that are being used in classrooms and labs. In some cases such as the Master Electrical Engineering module D on Electromagnetic radiation a revision of the recommended literature would also be advisable, since it occurs that there is only the title mentioned, but no author, in other cases there is an author but no title, etc. In addition, the module handbook forming part of the self-assessment report for the Master of Multimedia does not comprise a module description of the Master thesis. This should be included and published along with the other descriptions once the programme start working.

Despite the fact that staff and students agreed on the point that sufficient information on the course contents are distributed beforehand, the peers noticed, that the module descriptions forming part of the self-assessment reports are not publicly accessible to all stakeholders. Module descriptions published on the faculties' websites differ greatly in terms of the distribution of workload, assessments and lab work. Neither were these pieces of information available in the eClassrooms accessible to the peers. It has to be made sure,

that the latest versions of the module descriptions are always available to all stakeholders. Especially difficult is the situation for students of the Multimedia programmes who have to select their relevant information from the different websites of the faculty of Electrical Engineering and Computer Sciences respectively since the interdisciplinary programme is administered by the Faculty of Electrical Engineering concerning the Bachelor programme and the Faculty of Computer and Information Sciences concerning the Master programme. A combined website for the Multimedia Bachelor programme procuring all necessary rules and information does exist but is only linked to the website of Computer and Information Sciences. This should be made better accessible. The same is expected for the Master of Multimedia content once the programme is about to start. The peers shared this impression and would regard it necessary, that all study programme syllabi are clearly visible for all stakeholders and are easily accessible on a synchronized website.

#### **Criterion 5.2 Diploma and Diploma Supplement**

##### **Evidence:**

- Diploma Supplements for the respective study programmes
- Degree Certificate for the study programmes in Electrical Engineering

##### **Preliminary assessment and analysis of the peers:**

Diploma Supplements and Degree Certificates for the Bachelor and Master programmes in Electrical Engineering were presented to the peers covering most of the required information. Details regarding the level of qualification, the programme contents and the final mark are clearly stated. However, the relative ECTS grade allowing readers to categorize the individual result is missing. From an earlier accreditation process the peers are aware that the University of Ljubljana has already developed the necessary guidelines for the assessment of relative ECTS grades and it was explained that a relative ECTS grade will be included in all Diploma Supplements from 1 October 2016. Nevertheless, the peers ask the university to hand in the respective guidelines as additional documents. Furthermore, the peers missed completely the Diploma Supplements for the Bachelor and Master programmes in Multimedia which also should be provided in addition.

#### **Criterion 5.3 Relevant rules**

**Evidence:**

- Information on Rules and Regulations at the University of Ljubljana (e.g. code of ethics, ethics in research, international mobility of researchers) are presented on the University website: <https://www.uni-lj.si/university/> (accessed 09.11.2016)
- Homepage for the study programmes in Multimedia: <http://www.multimedia.info/eng/> (accessed 09.11.2016)
- Examination rules for the faculty of Electrical Engineering: [http://www.fe.uni-lj.si/en/education/students\\_office/rules\\_and\\_forms/](http://www.fe.uni-lj.si/en/education/students_office/rules_and_forms/) (accessed 09.11.2016)

**Preliminary assessment and analysis of the peers:**

The peers acknowledged that all rules and regulations governing the student life cycle, i.e. admission, progression and graduation were transparently published on the university website in English. The panel acknowledged that most rules and regulations regarding the study contents, exams or international exchange are openly available on the website to all persons interested. However, it was emphasized, that all information on the study programmes such as curricula und module descriptions should be accessible to all relevant stakeholders. This is explicitly important regarding a synchronization of the information presented on the Multimedia programme website.

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

The peers appreciated the efforts made by the HEI to refresh the module descriptions according to their recommendations. The missing description for the Master's thesis module in Multimedia has been added and it has been started to revise the descriptions with respect to recommended literature, included special topics and practical work. To improve the presentation of the Multimedia programmes is understood to require some more time. However, the peers welcome the unified presentation of course syllabi and curricula on the UL FE website. Consequently, they saw their requirements in this point as partly fulfilled.

The missing information in the Diploma Supplement regarding the relative ECTS grade have been satisfactorily been presented to the peers.

## 6. Quality management: quality assessment and development

<b>Criterion 6 Quality management: quality assessment and development</b>
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**Evidence:**

- Annual Report 2015 of the Faculty of Electrical Engineering: <http://www.fe.uni-lj.si/mma/annuel-report-2015-zadnji/2016082215061760/> (accessed 09.11.2016)
- 2015 Annual Report with the Quality Report of the Faculty of Computer and Information Sciences in the Self-Assessment Report of the Faculty
- Self-evaluation report of the University of Ljubljana: [https://www.uni-lj.si/university/quality/self\\_evaluation\\_report/](https://www.uni-lj.si/university/quality/self_evaluation_report/) (accessed 09.11.2016)
- Discussions with management, staff and students during the onsite visit

**Preliminary assessment and analysis of the peers:**

At the faculties of Electrical Engineering and Computer and Information Sciences several interrelated processes of quality management are employed. During the on-site-visit the peers got the impression, that student concerns are taken seriously and students have different options to voice concerns or demand improvement. Both faculties possess a Self-Evaluation and Accreditation Committee of eight members where apart from staff and faculty a student representative chosen from the Students' Council is involved. The Committee meets regularly in order to discuss current quality issues. Student representative are also involved in all bodies of the faculty management, out of 33 members of the senate there are seven student representatives. Every faculty composes an annual report among other aspects on quality management that is forwarded to University level and published as part of the University's Quality Assurance Report. However, the last openly accessible report on the University website dates from 2011.

In accordance with international standard the faculties also convey an evaluation of their alumni as well as an assessment by the industrial partners. The faculty of Electrical Engineering follows an individual survey of its graduates for some years now, combined with a newly issued survey among 283 Slovenian enterprises. The results are used to assess the strengths and weaknesses of graduates in order to meet the industry's demands (e.g. additional extracurricular courses to improve English language skills have been introduced in consequence of the survey). The faculty of Computer and Information Sciences is also conducting a survey among their graduates since 2013 but has not yet received sufficient replies for a satisfactory analysis due to the small number of graduates. In conclusion, the

peers understood that the QM-processes regarding the faculties' alumni are well appropriate.

Apart from the institutionalized participation of students in the quality management process the faculties also conduct a student survey at the end of each semester. The digitalized questionnaire is accessible to students via the electronic system STUDIS and can be answered voluntarily before registering for the course exam. In the discussion with students and staff it was explained, that there is no immediate feedback for every course, but the results are visible not only for the teacher but also the dean thus ensuring a control mechanism. The peers learned that the survey results as well as an assessment by the student council are also relevant aspects in any promotion process of teaching staff. By talking to the students the peers noticed that the impact of the voluntary survey is seen critically while the teaching staff is regarded very co-operative if contacted directly. As an example the Multimedia students recently contacted a professor regarding issues of mathematics and physics in a joint meeting with a responsible from the faculty of Computer and Information Sciences and a compromise could be established in order to improve the situation. Summarized the peers appreciated the close contact between faculty, staff and students, but demanded that the feedback on the survey to the students should be further institutionalized thereby closing the feedback-loop.

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

The peers accepted the reply of the HEI that the faculty of Engineering publishes its annual reports on its website regularly in Slovene as well as in English. Outdated reports on the University website are out of their control.

## **D Additional Documents**

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

- D 1. Samples of Diploma Supplements for the Multimedia programmes
- D 2. Rules for the assessment of relative ECTS-grades
- D 3. Information on the admission exams (see point 1.4)
- D 4. Module description for the Master thesis in Multimedia



## **E Comment of the Higher Education Institution (06.01.2017)**

The institution provided an extensive statement as well as additional documents on various topics.

## F Summary: Peer recommendations

Taking into account the additional information and the comments given by the University of Ljubljana, Faculty of Engineering 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
Bachelor of Multimedia	With requirements for one year	EUR-ACE label	30.09.2022
Master of Multimedia	With requirements for one year		30.09.2022
Academic Bachelor Study Programme in Electrical Engineering	With requirements for one year	EUR-ACE label	30.09.2022
Master in Electrical Engineering	With requirements for one year	EUR-ACE label	30.09.2022
Professional Bachelor Study Programme in Applied Electrical Engineering	With requirements for one year	EUR-ACE label	30.09.2022

### Requirements

A 1. (ASIIN 1.1) Draft the educational objectives/learning outcomes so that they describe the academic, subject-specific and professional classification of the qualifications gained in the degree programmes. In addition, make the qualification objectives accessible for all relevant stakeholders and ensure that the stakeholders can refer to them.

**Requirement for the Bachelor degree programmes in Electrical Engineering and Multimedia**

A 2. (ASIIN 3) The programmes must encompass a Bachelor thesis or a capstone project including a written thesis comparable to international standards, wherein the student proves that he/she is capable to carry out an assigned research task independently and at the Bachelor level of qualification.

**Recommendations**

E 1. (ASIIN 6) It is recommended to further develop and implement the quality assurance system. Thereby, feedback loops with regard to the student's feedback should be closed effectively.

E 2. (ASIIN 3) It is recommended to reduce the number of possible re-examinations in order to avoid an unnecessary prolongation of the study duration.

E 3. (ASIIN 2.3/1.3) It is recommended that experiments and laboratory work should require the student to independently find solutions to practical problems and report on it, even at the first-semester level.

## **G Comment of the Technical Committees (15.03.2017)**

### **Technical Committee 02 – ET/IT:**

The Technical Committee generally agrees with the positive assessment of the peers. Nevertheless, it considers some minor editorial modifications suitable. It suggests referring to “programme-specific learning outcomes” instead of the wider meaning of the term “educational objectives/learning outcomes” in requirement 1.

With reference to the expert panel’s assessment, the Technical Committee also concludes that the respective recommendation 1 should be confined to feedback processes within the framework of quality assurance, rather than to the quality assurance system as a whole.

On reasons of comparability as well as the lack of concrete indications for a significant prolongation of the study duration, the Technical Committee also considers the proposed restriction of a nation-wide ruling of re-sits inadequate. It therefore suggests deleting the respective recommendation 2.

The Technical Committee agrees with the expert panel that students should be encouraged to independently find solutions for practical problems in lab courses as early as possible. However, expecting them to do that already at the first semester-level would be a bit too demanding and unrealistic from the point of view of the Technical Committee. It therefore suggests using a broader term (“at the first-year level” instead of “at the first-semester level”).

In all other instances the Technical Committee agrees with the propositions of the expert panel.

### **Analysis and Assessment regarding the award of the EUR-ACE® Label**

The Technical Committee deems that the intended learning outcomes of the degree programmes do comply with the engineering specific part of Subject-Specific Criteria of the Technical Committee Electrical Engineer-ing and Information Technology.

The Technical Committee recommends awarding the seals as follows:

<b>Degree Programme</b>	<b>ASIIN seal</b>	<b>Subject-specific labels</b>	<b>Maximum duration of accreditation</b>
Academic Bachelor Study Programme in Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2022
Master in Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2022
Professional Bachelor Study Programme in Applied Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2022

#### **Technical Committee 04 – Informatics:**

The technical Committee discussed the procedure and followed the assessment of the peers without any changes.

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

The Technical Committee judges that the intended learning outcomes of the degree programme do comply with the engineering specific part of Subject-Specific Criteria of the Technical Committee 02 – ET/IT.

The Technical Committee 04 – Informatics recommends the award of the seals subjected to the final assessment of the peers as follows:

<b>Studiengang</b>	<b>ASIIN-Siegel</b>	<b>Fachlabel</b>	<b>Akkreditierung bis max.</b>
Bachelor of Multimedia	With requirements for one year	EUR-ACE®	30.09.2022
Master of Multimedia	With requirements for one year	EUR-ACE®	30.09.2022

## H Decision of the Accreditation Commission (31.03.2017)

*Assessment and analysis for the award of the ASIIN seal:*

The Committee discusses the programmes and follows the recommendations of the peers and the deletion of recommendation 2 as proposed by the Technical Committee 02. Additionally minor changes in wording are agreed on.

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

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

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

<b>Degree Programme</b>	<b>ASIIN-seal</b>	<b>Subject-specific label</b>	<b>Maximum duration of accreditation</b>
Bachelor of Multimedia	With requirements for one year	EUR-ACE®	30.09.2022
Master of Multimedia	With requirements for one year	EUR-ACE®	30.09.2022
Academic Bachelor Study Programme in Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2022
Master in Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2022
Professional Bachelor Study Programme in Applied Electrical Engineering	With requirements for one year	EUR-ACE®	30.09.2022

## **Requirements**

### **For all degree programmes**

A 1. (ASIIN 1.1) Re-write the programme-specific learning outcomes so that they describe the academic, subject-specific and professional classification of the qualifications gained in the degree programmes. In addition, make these learning outcomes accessible for all relevant stakeholders and ensure that the stakeholders can refer to them.

### **For the Bachelor degree programmes in Electrical Engineering and Multimedia**

A 2. (ASIIN 3) The programmes must encompass a Bachelor thesis or a capstone project including a written thesis comparable to international standards, wherein the student proves that he/she is capable to carry out an assigned research task independently and at the Bachelor level of qualification.

## **Recommendations**

### **For all degree programmes**

E 1. (ASIIN 6) Within the framework of the quality assurance system in use, feedback loops with regard to the student's feedback should be closed effectively.

E 2. (ASIIN 2.3/1.3) It is recommended that experiments and laboratory work should also require the student to independently find solutions to practical problems and report on it, even at the first year level.

## I Fulfilment of Requirements (23.03.2018)

### Analysis of the peers and the Technical Committees 02 (13.03.2018) and 04 (06.03.2018)

#### Requirements

##### For all degree programmes

- A 1. (ASIIN 1.1) Re-write the programme-specific learning outcomes so that they describe the academic, subject-specific and professional classification of the qualifications gained in the degree programmes. In addition, make these learning outcomes accessible for all relevant stakeholders and ensure that the stakeholders can refer to them.

Initial Treatment	
Peers	fulfilled Justification: The programme-specific learning outcomes now are clear and reasonably specific. The peers approved especially the Web-presentation of the learning outcomes, the curricula and the module descriptions. Vote: unanimous
TC 02	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment of the peers.
TC 04	fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment of the peers.
AC	fulfilled Vote: unanimous Justification: The Committee agrees with the assessment of the peers and the Technical Committees

##### For the Bachelor's programme in Electrical Engineering and Multimedia

- A 2. (ASIIN 3) The programmes must encompass a Bachelor thesis or a capstone project including a written thesis comparable to international standards, wherein the student proves that he/she is capable to carry out an assigned research task independently and at the Bachelor level of qualification.

Initial Treatment	
Peers	fulfilled



	<p>Justification: A Diploma thesis worth 6 ECTS credits, 3 ECTS credits in 5th and 3 ECTS credits in 6th semester has been introduced. The syllabus of the introduced Bachelor Diploma thesis was presented to the peers. Vote: unanimous</p>
TC 02	<p>fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment of the peers.</p>
TC 04	<p>fulfilled Vote: unanimous Justification: The Technical Committee agrees with the assessment of the peers.</p>
AC	<p>fulfilled Vote: unanimous Justification: The Committee agrees with the assessment of the peers and the Technical Committees</p>

## Decision of the Accreditation Commission (23.03.2018)

Degree programme	ASIIN-label	Subject-specific label	Accreditation until max.
Ba Multimedia	All requirements fulfilled	EUR-ACE®	30.09.2022
Ba Academic Study Programme in Electrical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2022
Ba Professional Study Programme in Applied Electrical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2022
Ma Electrical Engineering	All requirements fulfilled	EUR-ACE®	30.09.2022
Ma Multimedia	All requirements fulfilled	EUR-ACE®	30.09.2022

# Appendix: Programme Learning Outcomes and Curricula

The following **curricula** were presented:

## Bachelor of Multimedia:

	Types of courses	Course	L	S	T	C	I	C+I	ECTS
1st Semester	compulsory professional courses	Introduction to multimedia systems	45	0	30	75	105	180	6
	compulsory professional courses	Programming 1	45	0	30	75	105	180	6
	compulsory general courses	Career communication	45	0	30	75	75	150	5
	compulsory professional courses	Communication Systems	45	0	45	90	120	210	7
	compulsory general courses	Fundamentals of mathematical analysis	45	0	30	75	105	180	6
		<b>Total</b>		<b>225</b>	<b>0</b>	<b>165</b>	<b>390</b>	<b>510</b>	<b>900</b>
2nd Semester	compulsory general courses	Linear Algebra	45	0	30	75	105	180	6
	compulsory professional courses	Technical fundamentals of multimedia	45	0	30	75	135	210	7
	compulsory professional courses	Programming 2	45	0	30	75	105	180	6
	compulsory general courses	Computer Systems Architecture	45	0	30	75	105	180	6
	compulsory professional courses	Information Systems	45	0	15	60	90	150	5
		<b>Total</b>		<b>225</b>	<b>0</b>	<b>135</b>	<b>360</b>	<b>540</b>	<b>900</b>
	<b>Total</b>		<b>450</b>	<b>0</b>	<b>300</b>	<b>750</b>	<b>1050</b>	<b>1800</b>	<b>60</b>

	Types of courses	Course	L	S	T	C	I	C+I	ECTS
3rd Semester	compulsory professional courses	Internet Systems	45	0	30	75	105	180	6
	compulsory professional courses	Acoustics in Communication	45	0	30	75	105	180	6
	compulsory professional courses	Computer Graphics and Game Technology	45	0	30	75	105	180	6
	compulsory professional courses	Digital broadcasting systems	45	0	30	75	105	180	6
	compulsory general courses	Information and Communication Technology and Society	45	0	30	75	105	180	6
		<b>Total</b>		<b>225</b>	<b>0</b>	<b>150</b>	<b>375</b>	<b>525</b>	<b>900</b>
4th Semester	compulsory general courses	The basics of design	45	0	30	75	105	180	6
	compulsory general courses	Project management, innovation and teamwork	30	0	30	60	90	150	5
	compulsory professional courses	Digital Signal Processing	45	0	45	90	120	210	7
	compulsory professional courses	Mobile and Telematic Systems	45	0	30	75	105	180	6
	elective general courses (FRI)	Reliability and Performance of Computer Systems	45	0	30	75	105	180	6
	elective general courses	Computer Simulation	45	0	30	75	105	180	6
	elective general courses	Speech and Image Technology	45	0	30	75	105	180	6
	elective general courses	Telecommunication Protocols	45	0	30	75	105	180	6
	elective general courses								6
		<b>Total</b>							<b>900</b>
	<b>Total</b>							<b>1800</b>	<b>60</b>

	Types of courses	Course	L	S	T	C	I	C+I	ECTS
5th Semester	compulsory general courses	Introduction to Data Mining	45	0	30	75	105	180	6
	compulsory professional courses	Multimedia content	45	0	30	75	105	180	6
	compulsory professional courses	Web Programming	45	0	30	75	105	180	6
	compulsory professional courses	Communications security and content protection	45	0	30	75	105	180	6
	elective general courses (FRI)	Electronic Commerce	45	0	30	75	105	180	6
	elective general courses	Electronic Components and Sensors	45	0	30	75	105	180	6
	elective general courses								6
		<b>Total</b>						<b>900</b>	<b>30</b>
6th Semester	compulsory professional courses	Studio and multimedia production technology	45	0	30	75	105	180	6
	compulsory general courses	Editing and postproduction	30	0	45	75	105	180	6
	compulsory professional courses	Terminals and User Interfaces	45	0	30	75	105	180	6
	elective general courses (FRI)	Reliability and Performance of Computer Systems	45	0	30	75	105	180	6
	elective general courses	Computer Simulation	45	0	30	75	105	180	6
	elective general courses	Speech and Image Technology	45	0	30	75	105	180	6
	elective general courses	Telecommunication Protocols	45	0	30	75	105	180	6
	elective general courses (FRI)	Organization and Management	45	0	30	75	105	180	6
	elective general courses								6
	compulsory professional courses	Diploma Thesis	0	0	0	0	180	180	6
		<b>Total</b>						<b>900</b>	<b>30</b>
	<b>Total</b>						<b>1800</b>	<b>60</b>	

**Master of Multimedia:**

Course	Semester 1 L/S/T	Semester 2 L/S/T	ECTS
Transmission of Multimedia Signals	45/0/30		6
User-adapted Communication	45/0/30		6
Interaction and Information Design	45/20/10		6
Specialist elective course FRI 1	45/0/30		6
Specialist elective course FE 1	45/0/30		6
Multimedia Content Transfer		45/0/30	6
Data Mining		45/20/10	6
Advanced Software Development Methods		45/10/20	6
Specialist elective course FRI 2		45/0/30	6
Specialist elective course FE 2		45/0/30	6

Course	Semester 3 L/S/T	Semester 4 L/S/T	ECTS
Module FE - course 1 (student selects Module FE A or Module FE B)	45/0/30		6
Module FE - course 2 (student selects Module FE A or Module FE B)	45/0/30		6
Thematic set FRI – course 1 (student selects a course from the same Thematic set FRI A/B/C/D)	45/6,8/23,2		6
Thematic set FRI – course 2 (student selects a course from the same Thematic set FRI A/B/C/D)	45/6,8/23,2		6
General elective course	45/0/30		6
General elective course		45/0/30	6
Master's thesis			24

Specialist elective course FRI 1 (students choose 1 out of 3 offered)

Course	L/S/T	ECTS
Human-Computer Interaction	45/0/30	6
Information Security and Privacy	45/0/30	6
Digital Marketing	45/15/15	6

Specialist elective course FE 1 (students choose 1 out of 2 offered)

Course	L/S/T	ECTS
Sensor Systems and Multimedia	45/0/30	6
Visual Communication Design	45/0/30	6

Specialist elective course FRI 2 (students choose 1 out of 2 offered)

Course	L/S/T	ECTS
Numerical Mathematics	45/0/30	6
Web Information Extraction and Retrieval	45/10/20	6

Specialist elective course FE 2 (students choose 1 out of 2 offered)

Course	L/S/T	ECTS
Ambient Intelligence	45/0/30	6
Multimedia Content Processing	45/0/30	6

Module FE A (User-oriented) (Students choose 2 courses from one of the 2 modules offered)

Course	L/S/T	ECTS
Multimedia Terminals	45/0/30	6
User Experience and User Interfaces Design	45/0/30	6

Module FE B (System-oriented) (Students choose 2 courses from one of the 2 modules offered)

Course	L/S/T	ECTS
3D Sound in Multimedia	45/0/30	6
Embedded Systems in Multimedia	45/0/30	6

Thematic set FRI A (students choose 2 courses from the set offered; precondition: selection of Module FE A)

Course	L/S/T	ECTS
Human-Computer Interaction	45/0/30	6
Programming	45/10/20	6
Numerical Mathematics	45/0/30	6
Cloud Computing	45/20/10	6

## 0 Appendix: Programme Learning Outcomes and Curricula

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Thematic set FRI B (students choose 2 courses from the set offered; precondition: selection of Module FE A)

Course	L/S/T	ECTS
Human-Computer Interaction	45/0/30	6
Web Information Extraction and Retrieval	45/10/20	6
Natural Language Processing	45/10/20	6
Image Based Biometry	45/10/20	6

Thematic set FRI C (students choose 2 courses from the set offered; precondition: selection of Module FE B)

Course	L/S/T	ECTS
Computer Based Sound Production	45/0/30	6
Web Information Extraction and Retrieval	45/10/30	6
Natural Language Processing	45/10/20	6
Advanced Topics in Computer Vision	45/10/20	6
Advanced Computer Graphics	45/0/30	6
Numerical Mathematics	45/0/30	6
Image Based Biometry	45/10/20	6

Thematic set FRI D (students choose 2 courses from the set offered; precondition: selection of Module FE B)

Course	L/S/T	ECTS
Cloud Computing	45/20/10	6
Wireless Sensor Networks	45/10/20	6
Cryptography and Computer Security	45/10/20	6
Information Security and Privacy	45/0/30	6

General elective courses

Course	L/S/T	ECTS
Computer Science and Society I	5/0/0	3
Computer Science and Society II	5/0/0	3
Interdisciplinary projects	30/0/60	6
Any other general elective courses		

**Bachelor of Electrical Engineering:**

No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Mathematics I	Gregor Dolinar	60	0	45		120	225	9
2	Mechanics and thermodynamics	Aleš Iglíč	60	0	45		95	200	8
3	Fundamentals of Electrical Engineering I	Iztok Humar, Dejan Križaj	60	0	45		95	200	8
4	Introduction to Computer Programming	Iztok Fajfar	30	0	30		65	125	5
Total			210	0	165		375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Mathematics II	Gregor Dolinar	60	0	45		120	225	9
2	Atomics and optics	Aleš Iglíč	60	0	45		95	200	8
3	Fundamentals of Electrical Engineering II	Iztok Humar, Dejan Križaj	60	0	45		95	200	8
4	Programming of Microcontrollers	Iztok Fajfar	30	0	30		65	125	5
Total			210	0	165		375	750	30



**0 Appendix: Programme Learning Outcomes and Curricula**


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No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Mathematics III	Melita Hajdinjak, Gregor Dolinar	60	0	45		120	225	9
2	Measurements	Janko Drnovšek Dušan Agrež	45	0	45		85	175	7
3	Digital Structures	Tadej Kotnik	45	0	45		85	175	7
4	Communication Systems	Janez Bešter, Andrej Kos	45	0	45		85	175	7
Total			195	0	180		375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Mathematics IV	Melita Hajdinjak	45	0	30		75	150	6
2	Measurement Instrumentation	Dušan Agrež Janko Drnovšek	30	0	30		65	125	5
3	Electrical Machines	Damijan Miljavec	45	0	45		85	175	7
4	Semiconductor Electronics	Franc Smole	45	0	45		85	175	7
5	Elective Professional Course 1						65	125	5
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>CONTROL SYSTEMS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Control Systems Instrumentation	Sašo Blažič, Aleš Belič	45	0	45		85	175	7
2	Systems Analysis	Franjo Pernuš	45	0	45		85	175	7
3	Signals	France Mihelič	45	0	30		75	150	6
4	Introduction to Robotics	Marko Munih	30	0	30		65	125	5
5	Elective Professional Course 2		30	0	30		65	125	5
Total							375	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Electronics in Automation	Boštjan Murovec	45	0	45		85	175	7
2	Industrial Control Systems	Igor Škrjanc	45	0	45		85	175	7
3	Computer Simulation	Borut Zupančič	45	0	30		75	150	6
4	Elective Module						130	250	10
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**


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Option: <b>ELECTRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Linear Electronics	Andrej Žemva	45	0	45		85	175	7
2	Signals and Systems	Franc Smole	45	0	45		85	175	7
3	Electronic Components and Sensors	Matej Možek	45	0	30		75	150	6
4	Optoelectronics	Janez Krč	30	0	30		65	125	5
5	Elective Professional Course 2		30	0	30		65	125	5
Total							375	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Analog Electronic Circuits	Janez Krč	45	0	45		85	175	7
2	Discrete Signals and Systems	Andrej Levstek	45	0	45		85	175	7
3	Speech and Image Technology	France Mihelič	45	0	30		75	150	6
4	Elective Module						130	250	10
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>POWER ENGINEERING AND MECHATRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Electrical Power Networks and Devices	Boštjan Blažič	45	0	45		85	175	7
2	Control Engineering	David Nedeljković, Vanja Ambrožič	60	0	30		85	175	7
3	Electrical Machine Modelling	Damijan Miljavec	45	0	30		75	150	6
4	Fundamentals of Mechatronics	Vanja Ambrožič	30	0	30		65	125	5
5	Elective Professional Course 2						65	125	5
Total							375	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Electrical Power Systems	Miloš Pantoš	45	0	45		85	175	7
2	Power Electronics	Danijel Vončina Peter Zajec	60	0	30		85	175	7
3	High Voltage Engineering	Igor Papič	30	0	45		75	150	6
4	Elective Module						130	250	10
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>INFORMATION AND COMMUNICATION TECHNOLOGIES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Continuous Signals and Systems	Andrej Košir	45	0	45		85	175	7
2	Electrodynamics	Matjaž Vidmar	45	0	45		85	175	7
3	Information Theory and Source Coding	Andrej Levstek	45	0	30		75	150	6
4	Intelligent Systems	Matej Zajc, Marko Meža	45	0	15		65	125	5
5	Elective Professional Course 2		30	0	30		65	125	5
Total							375	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Digital Signal Processing	Sašo Tomažič	45	0	45		85	175	7
2	Digital Communication	Sašo Tomažič	45	0	45		85	175	7
3	Telecommunication Protocols	Drago Hercog	45	0	30		75	150	6
4	Elective Module						130	250	10
Total							375	750	30

<b>ELECTIVE COURSES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<b><i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester: Elective Professional Course 1</i></b>									
1	Automatic Control Systems	Borut Zupančič	45	0	15		65	125	5
2	Digital Electronic Systems	Andrej Trost	30	0	30		65	125	5
3	Energy and the Environment	Marko Čepin	30	0	30		65	125	5
4	Information Systems	Sašo Tomažič	45	0	15		65	125	5
<b><i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester: Elective Professional Course 2</i></b>									
1	Introduction to Robotics	Marko Munih	30	0	30		65	125	5
2	Optoelectronics	Janez Krč	30	0	30		65	125	5
3	Fundamentals of Mechatronics	Vanja Ambrožič	30	0	30		65	125	5
4	Intelligent Systems	Matej Zajc, Marko Meža	45	0	15		65	125	5
5	Numerical Methods	Gregor Dolinar	30	0	30		65	125	5

**0 Appendix: Programme Learning Outcomes and Curricula**

<b>ELECTIVE MODULES</b>									
<b>No.</b>	<b>Study unit</b>	<b>Lecturer</b>	<b>Contact hours</b>				<b>Individual stud. work</b>	<b>Total hours</b>	<b>ECTS</b>
			<b>Lecture</b>	<b>Seminar</b>	<b>Tutorial and lab</b>	<b>Other</b>			
<b>3<sup>rd</sup> Year - 6<sup>th</sup> Semester: Elective Modules</b>									
1	Module A: Virtual Reality	Matjaž Mihelj	30	0	30		65	125	5
2	Module A: Imaging Informatics	Boštjan Likar	30	0	30		65	125	5
3	Module B: Designing Embedded Systems	Tadej Tuma	30	0	30		65	125	5
4	Module B: Programming Embedded Systems	Tadej Tuma	30	0	30		65	125	5
5	Module C: Low-Voltage Electrical Installations	Grega Bizjak	30	0	30		65	125	5
6	Module C: Programmable Control Systems	David Nedeljković	30	0	30		65	125	5
7	Module D: World Wide Web	Jaka Sodnik	45	0	15		65	125	5
8	Module D: Multimedia Systems	Janez Bešter, Matevž Pogačnik	45	0	15		65	125	5
9	Module E: Project Management, Innovation and Teamwork	Damijan Miklavčič	30	0	30		65	125	5
10	Module E: Product Design and Development	Boštjan Likar	30	0	30		65	125	5

**Bachelor of Applied Electrical Engineering:**

No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Mathematics I	Melita Hajdinjak	60	0	60		105	225	9
2	Mechanics and heat	Aleš Iglič	45	0	45		85	175	7
3	Fundamentals of Electrical Engineering I	Iztok Humar, Dejan Križaj	60	0	60		105	225	9
4	Programming I	Iztok Fajfar	30	0	30		65	125	5
Total			195	0	195		360	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Mathematics II	Melita Hajdinjak	45	0	45		85	175	7
2	Atomics and optics	Aleš Iglič	45	0	30		75	150	6
3	Fundamentals of Electrical Engineering II	Dejan Križaj, Izток Humar	60	0	45		70	175	7
4	Programming II	Iztok Fajfar	30	0	30		65	125	5
5	Elective Course 1		30	0	30		65	125	5
Total							360	750	30



**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>CONTROL SYSTEMS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Measurements	Dušan Agrež	30	0	45		75	150	6
2	Digital Systems	Tadej Kotnik	45	0	30		75	150	6
3	Embedded Systems in Automatics	Marko Munih Roman Kamnik	45	0	30		75	150	6
4	Modelling and Simulation	Maja Atanasijević-Kunc	45	0	30		75	150	6
5	Control Technology Instrumentation	Sašo Blažič Aleš Belič	45	0	45		60	150	6
Total			210	0	180		360	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Electronics	Tomaž Jarm	30	0	30		65	125	5
2	Signal Analysis	France Mihelič	45	0	30		50	125	5
3	Systems and Control Design	Maja Atanasijević-Kunc	45	0	30		50	125	5
4	Servomotors	Tomaž Jarm	30	0	30		65	125	5
5	Robotics	Matjaž Mihelj	30	0	30		65	125	5
6	Elective Course 2						65	125	5
Total							360	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ELECTRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Measurements and Measurement Instrumentation	Dušan Agrež	45	0	30		75	150	6
2	Semiconductor Devices	Marko Topič	45	0	30		75	150	6
3	Linear Electronics	Arpad Bürmen	45	0	30		75	150	6
4	Development of Digital Systems	Matej Možek	45	0	30		75	150	6
5	Realisation of Electronic Circuits	Marko Jankovec	45	0	45		60	150	6
Total			225	0	165		360	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Components, Assemblies and Sensors	Matej Možek	45	0	45		60	150	6
2	Analog Electronic Circuits	Arpad Bürmen	45	0	45		85	175	7
3	Signal Processing	Andrej Levstek	45	0	45		85	175	7
4	Fundamentals of Microprocessor Electronics	Marko Jankovec	30	0	30		65	125	5
5	Elective Course 2						65	125	5
Total							360	750	30

0 Appendix: Programme Learning Outcomes and Curricula

Option: POWER ENGINEERING TECHNOLOGY AND SYSTEM AUTOMATION (ETAP)									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Elements of Electrical Power Networks	Boštjan Blažič	30	0	30		65	125	5
2	Analog and Digital Electronics	Peter Zajec	45	0	30		50	125	5
3	Measurement Techniques	Dušan Agrež	30	0	30		65	125	5
4	Fundamentals of Electrical Machines	Damijan Miljavec	45	0	30		50	125	5
5	Power System Operation and Planning	Miloš Pantoš	30	0	30		65	125	5
6	Technology of Materials	Danjel Vončina	45	0	15		65	125	5
Total			225	0	165		360	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Fundamentals of Control Engineering	David Nedeljković	45	0	15		65	125	5
2	Power Electronics	Rastko Fišer	45	0	30		50	125	5
3	Electrical Drive Systems	Rastko Fišer	45	0	30		50	125	5
4	Fundamentals of High Voltage Engineering	Boštjan Blažič	30	0	30		65	125	5
5	Electrical Installations and Lighting	Grega Bizjak	30	0	30		65	125	5
6	Elective Course 2						65	125	5
Total							360	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>QUALITY ENGINEERING</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Measurement Methods and Instrumentation	Janko Drnovšek, Jovan Bojkovski	45	0	45		60	150	6
2	Electronics with Digital Techniques	Boštjan Murovec	45	0	30		75	150	6
3	Software Engineering	Jovan Bojkovski	45	0	30		75	150	6
4	Microcontroller Systems	Marko Munih	45	0	30		75	150	6
5	Modelling and Signal Processing	Borut Zupančič	45	0	30		75	150	6
Total			225	0	165		360	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Metrology	Janko Drnovšek, Jovan Bojkovski	45	0	30		50	125	5
2	Statistical Process Control	Boštjan Likar	30	0	30		65	125	5
3	Regulation and Control Techniques	Igor Škrjanc, Vito Logar	30	0	30		65	125	5
4	Testing and Energy Efficiency	Igor Pušnik	45	0	30		50	125	5
5	Sensors and Data Acquisition	Samo Beguš	30	0	30		65	125	5
6	Elective Course 2						65	125	5
Total							360	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>INFORMATION AND COMMUNICATION TECHNOLOGIES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Signals and Information	Anton Umek	30	0	30		65	125	5
2	Radio Communications	Boštjan Batagelj	45	0	30		50	125	5
3	Telecommunication Networks	Drago Hercog	30	0	30		65	125	5
4	Introduction to communication electronics	Drago Strle	45	0	30		50	125	5
5	Microprocessor Systems in Telecommunications	Arpad Bürmen	30	0	30		65	125	5
6	Information Systems	Anton Kos	30	0	30		65	125	5
Total			210	0	180		360	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Digital Communications	Anton Umek	45	0	30		50	125	5
2	Digital Signal Processing	Urban Burnik	45	0	30		50	125	5
3	Project Management	Matej Zajc	30	0	30		65	125	5
4	Network Services	Andrej Kos, Matevž Pustišek	30	0	30		65	125	5
5	Optical Communication	Boštjan Batagelj	30	0	30		65	125	5
6	Elective Course 2						65	125	5
Total							360	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>CONTROL SYSTEMS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Communications in Automation	Stanislav Kovačič	45	0	45		85	175	7
2	Intelligent Systems in Automation	Simon Dobrišek	45	0	45		60	150	6
3	Computer Process Control	Gašper Mušič	45	0	45		85	175	7
4	Elective Professional Module						130	250	10
Total							360	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Work Practice						500	500	20
2	Diploma Thesis						250	250	10
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ELECTRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Communication Systems	Andrej Levstek	45	0	30		50	125	5
2	Computer Tools	Marko Jankovec	30	0	30		65	125	5
3	Embedded Systems	Tadej Tuma	45	0	30		50	125	5
4	Photonics	Janez Krč	30	0	30		65	125	5
5	Elective Professional Module						130	250	10
Total							360	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Work Practice						500	500	20
2	Diploma Thesis						250	250	10
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>POWER ENGINEERING TECHNOLOGY AND SYSTEM AUTOMATION (ETAP)</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Digital Control Systems	David Nedeljković	45	0	30		50	125	5
2	Electrical Energy Production	Marko Čepin	45	0	30		50	125	5
3	Operation of Electrical Power Systems during Disruptions	Rafael Mihalič	30	0	30		65	125	5
4	Power System Protection and Automation	Miloš Pantoš	30	0	30		65	125	5
5	Elective Professional Module						130	250	10
Total							360	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Work Practice						500	500	20
2	Diploma Thesis						250	250	10
Total							750	750	30



**0 Appendix: Programme Learning Outcomes and Curricula**

<b>Option: QUALITY ENGINEERING</b>									
<b>No.</b>	<b>Study unit</b>	<b>Lecturer</b>	<b>Contact hours</b>				<b>Individual stud. work</b>	<b>Total hours</b>	<b>ECTS</b>
			<b>Lecture</b>	<b>Seminar</b>	<b>Tutorial and lab</b>	<b>Other</b>			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Systems Quality	Janko Drnovšek	45	0	45		85	175	7
2	Robotics and Production Systems	Roman Kamnik	45	0	45		60	150	6
3	Reliability and Maintainability of Component and Systems	Marko Topič	45	0	45		85	175	7
4	Elective Professional Module						130	250	10
<b>Total</b>							<b>360</b>	<b>750</b>	<b>30</b>
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Work Practice						500	500	20
2	Diploma Thesis						250	250	10
<b>Total</b>							<b>750</b>	<b>750</b>	<b>30</b>

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>INFORMATION AND COMMUNICATION TECHNOLOGIES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>3<sup>rd</sup> Year - 5<sup>th</sup> Semester</i>									
1	Telecommunication Engineering	Iztok Humar, Janez Bešter	45	0	30		50	125	5
2	Mobile and Wireless Systems	Urban Burnik	30	0	30		65	125	5
3	Converged Multimedia Services	Matevž Pustišek, Andrej Kos	30	0	30		65	125	5
4	Telecommunication Protocols	Matevž Pustišek	45	0	30		50	125	5
5	Elective Professional Module						130	250	10
Total							360	750	30
<i>3<sup>rd</sup> Year - 6<sup>th</sup> Semester</i>									
1	Work Practice						500	500	20
2	Diploma Thesis						250	250	10
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

<b>ELECTIVE COURSES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<b><i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester: Elective Course 1</i></b>									
1	Automatic Control	Gašper Mušič	30	0	30		65	125	5
2	Programmable Digital Systems	Andrej Trost	30	0	30		65	125	5
3	Mechatronics	Vanja Ambrožič	30	0	30		65	125	5
4	Communication Systems	Andrej Kos, Matevž Pustišek	30	0	30		65	125	5
5	Tehncial Quality	Janko Drnovšek, Gaber Begeš	30	0	30		65	125	5
<b><i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester: Elective Course 2</i></b>									
1	Robotics	Matjaž Mihelj	30	0	30		65	125	5
2	Fundamentals of Microprocessor Electronics	Marko Jankovec	30	0	30		65	125	5
3	Electrical Installations and Lighting	Grega Bizjak	30	0	30		65	125	5
4	Optical Communication	Boštjan Batagelj	30	0	30		65	125	5
5	Sensors and Data Acquisition	Samo Beguš	30	0	30		65	125	5
6	English A1 – B2	Marina Štros-Bračko	30	0	30		65	125	5
7	Physical Education	Iztok Mihevc	10	0	65		50	125	5

**0 Appendix: Programme Learning Outcomes and Curricula**

<b>ELECTIVE MODULES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<b>3<sup>rd</sup> Year - 5<sup>th</sup> Semester: Elective Modules</b>									
1	Module A: Measurement Systems in Processes	Janko Drnovšek, Dušan Agrež, Jovan Bojkovski	30	0	30		65	125	5
2	Module A: Control of Quality and Reliability	Gaber Begeš	30	0	30		65	125	5
3	Module B: Integrated Circuits	Andrej Žemva	30	0	30		65	125	5
4	Module B: Digital Electronic Systems Design	Andrej Žemva	30	0	30		65	125	5
5	Module C: Electromagnetic Devices Design	Danilo Makuc, Damijan Miljavec	30	0	30		65	125	5
6	Module C: Electrical Power Engineering	Marko Čepin	30	0	30		65	125	5
7	Module D: Communication Security	Anton Umek	30	0	30		65	125	5
8	Module D: Satellite Communication and Navigation	Boštjan Batagelj	30	0	30		65	125	5
9	Module E: Software Quality	Jovan Bojkovski	30	0	30		65	125	5
10	Module E: Innovation Process and Patenting	Igor Pušnik	30	0	30		65	125	5
11	Module F: Applied Electromagnetics	Iztok Humar, Dejan Križaj	30	0	30		65	125	5
12	Module F: Practical Mathematics	Melita Hajdinjak	30	0	30		65	125	5

**Master of Electrical Engineering:**

Option: CONTROL SYSTEMS AND COMPUTER ENGINEERING									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Digital Control	Sašo Blažič	45	0	30		75	150	6
2	Pattern Recognition	Simon Dobrišek	45	0	30		75	150	6
3	Modelling Methods	Maja Atanasijević-Kunc	45	0	30		75	150	6
4	Computer Vision	Stanislav Kovačič	45	0	30		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Automated and Virtual Measurement Systems	Janko Drnovšek, Jovan Bojkovski	45	0	30		75	150	6
2	Embedded Systems	Stanislav Kovačič	30	0	45		75	150	6
3	Information Theory and Coding	Simon Dobrišek	45	0	30		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>BIOMEDICAL ENGINEERING</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Biological Systems	Damijan Miklavčič, Tadej Kotnik	45	0	30		75	150	6
2	Biomedical Informatics	Tomaž Vrtovec	45	0	30		75	150	6
3	Measurements and Sensors in Biomedicine	Alenka Maček Lebar	45	0	30		75	150	6
4	Biomedical Electronics	Tomaž Jarm	45	0	30		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Neurocybernetics	Damijan Miklavčič	45	0	30		75	150	6
2	Biomedical Signal Processing	Tomaž Jarm	45	0	30		75	150	6
3	Medical Imaging Technologies	Boštjan Likar	30	0	45		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ELECTRICAL POWER ENGINEERING</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Circuits and Signals in Power Engineering	Andrej Košir	45	0	30		75	150	6
2	Conventional energy sources	Marko Čepin	45	0	30		75	150	6
3	Power System Disturbances	Rafael Mihalič	45	0	30		75	150	6
4	Generators and Transformers	Damijan Miljavec	45	0	30		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Power System Design and Maintenance	Miloš Pantoš	45	0	30		75	150	6
2	Power Distribution and Industrial Systems	Grega Bizjak	45	0	30		75	150	6
3	Electrical Drives	Rastko Fišer	45	0	30		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ELECTRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Mobile Systems	Sašo Tomažič	45	0	30		75	150	6
2	Digital design	Matej Možek	45	0	30		75	150	6
3	Non-Linear Electronic Circuits	Marko Topič	45	0	30		75	150	6
4	Circuit Analysis and Optimisation	Tadej Tuma	45	0	30		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Nanoelectronics	Franc Smole	45	0	30		75	150	6
2	Control Systems	Borut Zupančič	45	0	30		75	150	6
3	Analogue Integrated Circuits and Systems	Anton Pleteršek, Drago Strle	45	0	30		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30



**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>MECHATRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Circuits and Signals in Power Engineering	Andrej Košir	45	0	30		75	150	6
2	Conventional Electricity Sources	Marko Čepin	45	0	30		75	150	6
3	Generators and Transformers	Damijan Miljavec	45	0	30		75	150	6
4	Industrial Electronics	Peter Zajec	45	0	30		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Digital Processing in Mechatronics I	Danjel Vončina	45	0	30		75	150	6
2	Electric Servo Systems	Vanja Ambrožič	45	0	30		75	150	6
3	Electrical Drives	Rastko Fišer	45	0	30		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30

0 Appendix: Programme Learning Outcomes and Curricula

Option: <b>ROBOTICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Digital Control	Sašo Blažič	45	0	30		75	150	6
2	Robot Kinematics and Dynamics	Marko Munih	45	0	30		75	150	6
3	Complex Measurement Systems	Janko Drnovšek, Dušan Agrež, Jovan Bojkovski	45	0	30		75	150	6
4	Robotic and Measurement Embedded Systems	Domen Hudoklin, Roman Kamnik	30	0	45		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Automated and Virtual Measurement Systems	Janko Drnovšek, Jovan Bojkovski	45	0	30		75	150	6
2	Robot Vision	Franjo Pernuš	30	0	45		75	150	6
3	Robot Control	Matjaž Mihelj	30	0	45		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: TELECOMMUNICATIONS									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester</i>									
1	Networks I	Janez Bešter, Andrej Kos	45	0	30		75	150	6
2	Digital signal and video processing	Andrej Košir	45	0	30		75	150	6
3	Software for telecommunications systems	Andrej Kos	45	0	30		75	150	6
4	Antennas and wave propagation	Matjaž Vidmar	45	0	30		75	150	6
5	Elective General Course 1						75	150	6
Total							375	750	30
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester</i>									
1	Optical communications	Matjaž Vidmar	45	0	30		75	150	6
2	Design and management of telecommunication systems	Janez Bešter, Iztok Humar	45	0	30		75	150	6
3	Operations research in telecommunications	Andrej Košir	45	0	30		75	150	6
4	Elective Professional Module 1						150	300	12
Total							375	750	30

0 Appendix: Programme Learning Outcomes and Curricula

Option: CONTROL SYSTEMS AND COMPUTER ENGINEERING									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Autonomous Mobile Systems	Gregor Klančar	45	0	30		75	150	6
2	Elective Professional Module 2						225	450	18
3	Elective General Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>BIOMEDICAL ENGINEERING</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Medical Image Analysis	Franjo Pernuš	30	0	45		75	150	6
2	Intelligent Methods of Data Mining in Biomedicine	Igor Škrjanc	45	0	30		75	150	6
3	Bioelectromagnetics	Tadej Kotnik, Peter Gajšek	45	0	30		75	150	6
4	Seminar: Biomedical Engineering	Franjo Pernuš	15	0	60		75	150	6
5	Elective General Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ELECTRICAL POWER ENGINEERING</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Power System Dynamic Phenomena	Rafael Mihalič	45	0	30		75	150	6
2	Power System Protection and Control	Miloš Pantoš	45	0	30		75	150	6
3	Power Quality	Igor Papič	45	0	30		75	150	6
4	Seminar in Electrical Power Engineering	Marko Čepin	15	0	60		75	150	6
5	Elective general Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ELECTRONICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Digital Integrated Circuits and Systems	Andrej Žemva	45	0	30		75	150	6
2	Microelectronic Systems	Drago Strle	45	0	30		75	150	6
3	Real-Time Operating Systems	Tadej Tuma	45	0	30		75	150	6
4	Seminar: Electronics	Marko Jankovec	15	0	60		75	150	6
5	Elective general Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30

0 Appendix: Programme Learning Outcomes and Curricula

Option: MECHATRONICS									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Digital Processing in Mechatronics II	Vanja Ambrožič	45	0	30		75	150	6
2	Integrated Drive Systems	Rastko Fišer	30	0	45		75	150	6
3	Sensors and Measurement Transducers	Peter Zajec	45	0	30		75	150	6
4	Seminar: Mechatronics	Danjel Vončina	15	0	60		75	150	6
5	Elective general Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30



**0 Appendix: Programme Learning Outcomes and Curricula**

Option: <b>ROBOTICS</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Autonomous Mobile Systems	Gregor Klančar	45	0	30		75	150	6
2	Robotic Mechanisms	Marko Munih, Jadran Lenarčič	45	0	30		75	150	6
3	Haptic Robots	Matjaž Mihelj	45	0	30		75	150	6
4	Seminar: Robotics and Measurements	Marko Munih Janko Drnovšek	15	0	60		75	150	6
5	Elective general Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30

**0 Appendix: Programme Learning Outcomes and Curricula**


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Option: TELECOMMUNICATIONS									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester</i>									
1	Information and communication systems security	Sašo Tomažič	45	0	30		75	150	6
2	Seminar on the design and development of software in telecommunications	Jaka Sodnik	15	0	60		75	150	6
3	Elective Professional Module 3						150	300	12
5	Elective general Course 2						75	150	6
Total							375	750	30
<i>2<sup>nd</sup> Year - 4<sup>th</sup> Semester</i>									
1	Master's Thesis						750	750	30
Total							750	750	30

0 Appendix: Programme Learning Outcomes and Curricula

ELECTIVE COURSES									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 1<sup>st</sup> Semester: Elective General Course 1</i>									
1	Artificial Intelligent Systems	Simon Dobrišek	45	0	30		75	150	6
2	Design of electro-mechanical assemblies	Matjaž Mihelj, Roman Kamnik	45	0	30		75	150	6
3	Numerical Modelling of Physical Phenomena in Engineering, Biology and Medicine	Alenka Maček Lebar	30	0	45		75	150	6
4	Construction of Electronic Systems	Marko Jankovec	45	0	30		75	150	6
5	Lighting Engineering	Grega Bizjak	30	0	45		75	150	6
6	Mechatronic Systems	Vanja Ambrožič	30	0	45		75	150	6
7	Acoustics in Communication	Jaka Sodnik	45	0	30		75	150	6
8	Applied Statistics	Gregor Dolinar, Melita Hajdinjak	60	0	15		75	150	6

**0 Appendix: Programme Learning Outcomes and Curricula**

<b>ELECTIVE COURSES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<b>2<sup>nd</sup> Year - 1<sup>st</sup> Semester: Elective Professional Course 2</b>									
1	Advanced Control Design Methods	Maja Atanasijević-Kunc	45	0	30		75	150	6
2	Acoustics and Ultrasound	Samo Beguš	45	0	30		75	150	6
3	Communication in Research and Development	Damijan Miklavčič	30	0	45		75	150	6
4	High-Frequency Circuits	Drago Strle	45	0	30		75	150	6
5	Increasing Power System Transmission Capacity	Rafael Mihalič	45	0	30		75	150	6
6	Design of Electrical Machines	Damijan Miljavec	30	0	45		75	150	6
7	Communication Electronics	Matej Zajc	45	0	30		75	150	6
8	Physics of Matter	Tomaž Gyergyek, Veronika Kralj Igljč	60	0	15		75	150	6
9	Interdisciplinary projects	Andrej Kos, Boštjan Likar, Janez Bešter, Damijan Miklavčič	30	0	60		75	150	6

**0 Appendix: Programme Learning Outcomes and Curricula**

<b>ELECTIVE MODULES</b>									
<b>No.</b>	<b>Study unit</b>	<b>Lecturer</b>	<b>Contact hours</b>				<b>Individual stud. work</b>	<b>Total hours</b>	<b>ECTS</b>
			<b>Lecture</b>	<b>Seminar</b>	<b>Tutorial and lab</b>	<b>Other</b>			
<b><i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester: Elective Professional Module 1</i></b>									
1	Module A: Intelligent Systems in Decision and Control	Igor Škrjanc	45	0	30		75	150	6
2	Module A: Identification	Sašo Blažič	45	0	30		75	150	6
3	Module B: European Technical Legislation and Infrastructure	Janko Drnovšek, Gaber Begeš	45	0	30		75	150	6
4	Module B: Quality Engineering	Janko Drnovšek, Gaber Begeš	45	0	30		75	150	6
5	Module C: Robot-Human Interaction	Matjaž Mihelj	30	0	45		75	150	6
6	Module C: Biomechanics	Roman Kamnik	45	0	30		75	150	6
7	Module D: Electromagnetics	Anton Sinigoj	45	0	30		75	150	6
8	Module D: Electromagnetic Radiation	Andrej Košir	45	0	30		75	150	6
9	Module E: Alternative Energy Sources and Electricity Markets	Marko Čepin, Miloš Pantoš	45	0	30		75	150	6
10	Module E: Power Engineering	Rafael Mihalič	45	0	30		75	150	6

<b>ELECTIVE MODULES</b>									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
<i>1<sup>st</sup> Year - 2<sup>nd</sup> Semester: Elective Professional Module 1</i>									
11	Module F: Modern Power Supplies	Peter Zajec	30	0	45		75	150	6
12	Module F: Materials and Technologies	Danjel Vončina	60	0	15		75	150	6
13	Module G: Terminal Devices and User Interfaces	Jaka Sodnik	45	0	30		75	150	6
14	Module G: Mobile and Telematic Systems	Janez Bešter, Drago Hercog	45	0	30		75	150	6

<b>ELECTIVE MODULES</b>									
<b>OPTION: CONTROL SYSTEMS AND COMPUTER ENGINEERING</b>									
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester: Elective Professional Module 2</i>									
1	Module H: Production Management	Gašper Mušič	45	0	30		75	150	6
2	Module H: Industrial Informatics	Gašper Mušič	45	0	30		75	150	6
3	Module H: Seminar: Intelligent Control	Gašper Mušič	15	0	60		75	150	6
4	Module I: Imaging Technologies	Stanislav Kovačič	30	0	45		75	150	6
5	Module I: Speech Technologies	France Mihelič	45	0	30		75	150	6
6	Module I: Seminar: Biometric Systems	Simon Dobrišek	15	0	60		75	150	6
<b>OPTION: TELECOMMUNICATIONS</b>									
<i>2<sup>nd</sup> Year - 3<sup>rd</sup> Semester: Elective Professional Module 3</i>									
1	Module J: Telecommunications services	Janez Bešter, Matevž Pogačnik	45	0	30				
2	Module J: Networks II	Andrej Kos	45	0	30				
3	Module K: Satellite communications and navigation	Boštjan Batagelj	45	0	30				
4	Module K: High-frequency technology	Matjaž Vidmar	45	0	30		75	150	6

ELECTIVE COURSES for students of non-engineering study programmes									
No.	Study unit	Lecturer	Contact hours				Individual stud. work	Total hours	ECTS
			Lecture	Seminar	Tutorial and lab	Other			
1	Communications and Society	Janez Bešter, Andrej Kos, Matevž Pogačnik	45	0	15		65	125	5
2	Sustainable power supply	Marko Čepin, Rafael Mihalič, Valentin Ažbe, Boštjan Blažič	45	0	15		65	125	5