ASIIN Accreditation Report

Bachelor's and Master's Degree Programmes

- *Electrical Engineering and Information Technology*
- *Computing*

Master's Degree Programme

- *Information and Communication Technology*

offered by

University of Zagreb

Last update: 22.03.2013

ASIIN Accreditation procedure including an on-site visit for

Bachelor's and Master's Degree Programmes

- ***Electrical Engineering and Information Technology***
- ***Computing***

Master's Degree Programme

- ***Information and Communication Technology***

offered by

University of Zagreb
on 18th and 19th December, 2012

- Reaccreditation -

Quality Labels Applied For

Within the scope of assessing the degree programmes, University of Zagreb applied for the award of these labels:

- ASIIN seal for individual degree programmes
- EUR-ACE for Engineering Programmes
- Euro-Inf for Computing Programmes

Audit Team

Prof. Dr. Hartmut Ernst	University of Applied Sciences Rosenheim
Dr.-Ing. Kruno Hernaut	Formerly Siemens AG
Prof. Dr.-Ing. Kristian Kroschel	Karlsruhe Institute of Technology
Prof. Dr. Rüdiger Reischuk	University of Lübeck
- no student auditor nominated in time -	

ASIIN staff member: Dr. Siegfried Hermes

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A Preliminary Remark

The on-site visit for the Bachelor and Master degree programmes Electrical Engineering and Information Technology and Computing as well as the Master degree programme Information and Communication Technology took place at the University in Zagreb, Faculty of Electrical Engineering and Computing on 18th and 19th of December, 2012.

Prior to the talks with the representatives of the university, the peers met to prepare their questions and to discuss the self-assessment report. Professor Kroschel was asked to act as speaker of the audit team for the aforementioned degree programmes. ASIIN's Technical Committees 02 – "Electrical Engineering / Information Technology" and 04 – "Informatics / Computer Science" are responsible for the accreditation procedure of these programmes.

The aforementioned degree programmes have already been accredited on 23.03.2006 by ASIIN.

The peers held discussions with the following groups: University management, responsible managers of degree programmes, teaching staff, students and graduates.

Additionally, the auditors inspected the infrastructure and the technical equipment at Zagreb.

The following chapters relate to the Self Assessment Report (hereinafter *SAR*) provided by the University of Zagreb, Faculty of Electrical Engineering and Computing in October 2012 as well as to the discussions and information provided during the on-site visit including samples of exams and final theses.

The assessment and the award of the ASIIN-seal are always based on the European Standards and Guidelines (ESG) and the Subject-Specific Criteria of Technical Committees 02 – "Electrical Engineering / Information Technology" as well as 04 – "Informatics / Computer Science", valid at the time of conclusion of the contract. In case of the award of other seals or labels, the criteria of the respective seal or label-owner (ENAEE) are considered additionally.

Based on the „EUR-ACE Framework Standards for the Accreditation of Engineering Programmes", ENAEE as owner of the label has authorized ASIIN to award the EUR-ACE® Label. The assessment for the award of the EUR-ACE® Label is based on the General Criteria of ASIIN as well as on the Subject-Specific Criteria (SSC) of the Technical Committee 02.

Based on the „Euro-Inf Framework Standards and Accreditation Criteria", EQANIE as owner of the label has authorized ASIIN to award the Euro-Inf® Label. The assessment for the award of the Euro-Inf® Label based on the General Criteria of ASIIN as well as on the Subject-Specific Criteria (SSC) of the Technical Committee 04 - Informatics.

The report has the following structure: Chapter B presents the facts which are necessary for the assessment of the requested seals. The information principally stems for the self-assessment report and related appendices provided by the Higher Education Institution. The following chapters include separate assessments of the peers about the compliance with the criteria for the requested seals. The statement of the HEI is subsequently included with the exact wording. The final recommendation of the peers and the Technical Committees as well as the final decision of the Accreditation Commission are drafted after and based on the statement of the HEI (and additional documents, if applicable).

Any gender-specific terms used in this document apply to both women and men.

B Description of the degree programmes

B-1 Formal specifications

a) Name & Awarded Degree	d) Study-Mode	e) Programme Duration & Credit points	f) first & annual enrollment	g) expected intake	h) fees
Electrical Engineering and Information Technology / B.Sc. in Electrical Engineering and Information Technology	Full time	6 semester 180 CP	WS 2005/06 WS	ca 325 per year	none for the first year (Croatian students only; first enrolment); besides 4000 HRK per study year
Computing / B.Sc. in Computing	Full time	6 Semester 180 CP	WS 2005/06 WS	ca 325 per year	none for the first year (Croatian students only; first enrolment); besides 4000 HRK per study year
Electrical Engineering and Information Technology / M.Sc. in Electrical Engineering and Information Technology	Full time	4 semester 120 CP	WS 2008/09 WS	ca 180 per year	none for the first year (Croatian students only; first enrolment); besides 4000 HRK per study year
Computing / M.Sc. in Computing	Full time	4 Semester 120 CP	WS 2008/09 WS	ca 180 per year	none for the first year (Croatian students only; first enrolment); besides 4000 HRK per study year
Information and Communication Techno-logy / M.Sc. in Informa-tion and Communication Technology	Full time	4 Semester 120 CP	WS 2008/09 WS	ca 180 per year	none for the first year (Croatian students only; first enrolment); besides 4000 HRK per study year

Analysis of Peers:

In general, the name of the resp. study programme reflects the study aims and learning outcomes the Faculty of Electrical Engineering and Computing (FER) has committed itself to. Also, the name, by and large, reflects the disciplinary content of the resp. study programme. Nevertheless, labelling of the different “modules” in terms of *specialisation tracks* of the study programmes under consideration raises the question of consistency when looking at identical designations of “modules” and “profiles” in Bachelor’s and Master’s programmes that are not designed to be consecutive in the narrow sense. The peers will return to that problem in the following chapter (B-2.2).

Standard period of study and allocated credit points, expected intakes per study year and tuition fees are within regular range. As to the degree awarded, the information provided in the SAR and the acronyms used in the diploma supplements at hand seem to be unnecessary lengthy and complicated. But as it turns out, especially the acronyms refer, in Croatian language, to the familiar “Bachelor of Science” or “Master of Science” specified through the name of the study programme.

Assessment of Peers; ASIIN criterion 1:

The peers judge the requirements of the said criterion to be adequately met. (With respect to the conception of specialization tracks see below chapters B-2.2, 2-6.) Overall, they suggest using the term “module” in the technical sense of comprehensive learning and teaching entity it is usually employed in the context of the Bologna process, thus avoiding any misunderstanding.

B-2 Degree Programme: content concept & implementation

B-2.1 Objectives of the degree programmes

According to the HEI study aims of the degrees are as follows:

Bachelor’s programme Electrical Engineering and Information Technology:

“Electrical Engineering covers the application of physical laws about electromagnetic phenomena in development of products and services that provide a benefit to the mankind. Information technology, which uses computers, computer networks, communication systems and technology to sense, process, store and display the information, today has a significant impact on electrical engineering. Nowadays, it is almost impossible to come across an activity within electrical engineering that is not interconnected with information technology. Thus, these areas have been joined into the first cycle study program of Electrical Engineering and Information Technology.” (SAR, p.2)

Bachelor’s programme Computing:

„The principal object of study in computing is the computer as a universal data processing machine, together with the methods of its application in diverse areas. The holistic approach to hardware, software, and hardware-software dependencies is used. Computing encompasses the theory, methods of analysis and synthesis, design and construction, application and operation of computer systems.” (SAR, p.32)

Additionally, concerning both undergraduate degree programmes:

“Within the framework of undergraduate studies, the Faculty enables the students for professional work in specified professions and for continuation of education on graduate studies.” (Article 3, sec. 1, regulations of the university undergraduate and graduate studies...).

Master’s programme Electrical and Information Technology:

“Electrical engineering covers the application of physical laws about electromagnetic phenomena in development of products and services that provide a benefit to the mankind. Information technology, which uses computers, computer networks, communication systems and technology to sense, process, store and display the information, today has a significant impact on electrical engineering. Nowadays, it is almost impossible to come across an activity within electrical engineering that is not interconnected with information technology. Thus, these areas have been joined into the second cycle study program of Electrical engineering and information technology. This program enables a student to acquire the competencies to solve difficult engineering problems, to design complex systems, to act as a leader of a team and to conduct research and development in one of five profiles [i.e. specialization track].” (SAR, p.58)

Master’s programme Computing:

“The principal object of study in computing is the computer as a universal data processing machine, together with the methods of its application in diverse areas. The holistic approach to hardware, software, and hardware-software dependencies is used. Computing encompasses the theory, methods of analysis and synthesis, design and construction, application and operation of computer systems. This second cycle study program enables a student to acquire the competencies to solve difficult engineering problems, to design complex systems, to act as a leader of a team and to conduct research and development in one of three profiles [i.e. specialization track].” (SAR, p.128/129)

Master’s programme Information and Communication Technology:

“Information and communication technology enables the transfer and utilization of all kinds of information, therefore presenting the most penetrating contemporary generic technology. As such, it is the foundation of economy and society in the 21st century. This technology generates changes in all spheres of the society. It is applicable in all branches of economy and all areas of science, and it is the background for successful entrepreneurship, as well as for all social and governmental structures. This second cycle study program enables a student to acquire the competencies to solve difficult engineering problems, to design complex systems, to act as a leader of a team and to conduct research and development in one of three profiles [i.e. specialization track].“ (SAR, p.100/101)

Additionally, concerning all graduate degree programmes:

“Within the framework of graduate studies, the Faculty enables the students for highly professional work in specified professions and for continuation of education on postgraduate studies.” (Article 3, sec. 2, regulations of the university undergraduate and graduate studies...).

Analysis of Peers:

The FER has duly classified the final degree in academic and professional terms. The formulated study aims reasonably refer to the qualification sought in a discipline related manner and in accordance with the EQR. This classification has been made publicly accessible for stakeholderns on the Faculty’s website.

Assessement of Peers; ASIIN Criterion 2.1:

The peers find the requirements of the criterion to be sufficiently met with the information at hand.

B-2.2 Learning outcomes of the degree programmes

The HEI enumerates the following intended learning outcomes for the degree programmes:

Bachelor’s programme Electrical Engineering and Information Technology

General outcomes

Knowledge and understanding of...

- Appropriate mathematical principles and techniques underlying electrical engineering and information technology including linear algebra, calculus, vector calculus and integral transforms;
- The science principles underlying electrical engineering and information technology systems;
- The key aspects and concepts of electrical engineering including circuit and field theory, electronics, signals and systems, electrical energy technology, and automatic control;
- The key aspects and concepts of information technology including digital logic, programming, algorithms and data structures, computer architecture, communication systems, and information theory;
- The branch of electrical engineering and information technology based on the knowledge and understanding of fundamental principles given in common courses, as well as some forefront of the branch focused on in specialization courses;
- The social, ethical, business and legal context of engineering.

Engineering analysis...

- The ability to apply gained knowledge and understanding to identify, formulate and solve engineering problems;
- The ability to apply gained knowledge and understanding in the analysis of electrical engineering and information technology products, processes and methods;
- The ability to select and apply relevant analytic and modelling methods and to program a computer to solve the problem.

Engineering design abilities...

- The ability to apply gained knowledge and understanding to develop and realize a design to meet defined and specified requirements;
- An understanding of design methodologies in electrical engineering and information technology, and an ability to use appropriate mathematical methods or information technology tools.

Investigations abilities...

- The ability to conduct searches of literature, and to use databases and other sources of information;
- The ability to design and conduct appropriate experiments in electrical engineering and information technology, to interpret the data and to draw conclusions;
- Workshop and laboratory skills to use relevant laboratory equipment and to analyze the results critically.

Engineering practice...

- Students learn to select and apply appropriate scientific principles, mathematical and computer based methods for analyzing general electric engineering and information technology systems;
- They gain the ability to combine theory and practice to solve problems in electric engineering and information technology;
- They develop an understanding of applied techniques and methods, as well as an understanding of their limitations;
- They develop an awareness of the social impacts of engineering practice.

Transferable skills...

- The ability to function effectively as an individual or as a member of a team, and to present the work both in written and oral form;
- The ability to use diverse methods to communicate effectively with the engineering community and with society at large;
- An awareness of the health, safety, legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commitment to professional ethics and responsibilities, as well as the norms of engineering practice;
- An awareness of project management and business practices, and the ability to utilize project management methods;
- The ability to recognize the need for further learning, and the ability to engage in independent, life-long learning.

For the specialization track *Control Engineering and Automation* (“module” in the wording of FER)

- Control Engineering and Automation as multidisciplinary technological and engineering fields comprise the following knowledge: determination of requirements and criteria for control systems design related to flow of matter, energy and information.
- Comprehension of methods for information processing and data acquisition in the control and automation systems and methods for systems analysis and formal representation of control systems.
- Application of control systems elements (hardware and software modules) for process automation, automation of manufacturing plants, computer-controlled systems, electromechanical systems, and process measurements and actuators.
- Analysis of basic dynamic components of control systems and stability of linear control systems. Analysis of discretization methods and mathematical models of discrete-time linear systems.

For the specialization track *Electrical Power Engineering*

- Knowledge in analysis and modelling of basic elements of power system (transformers, transmission lines, rotating machines and power semiconductor devices). Knowledge in calculation of short circuit currents using symmetrical components, electric parameters of overhead lines and power equipment dimensioning.
- Comprehension of synchronous generator operation principles, arc interrupting techniques and purposes of transmission and distribution system. Comprehension of

methods used in design and control of electric machines, electronic power converters, transmission lines, substations and switchgear systems.

- Application of rotating machines for electromechanical conversion and transformers and overhead lines for power transmission and distribution
- Application of models of power system elements for determination of current and voltage states under normal and short circuit conditions.
- Analysis of power substations grounding, relay protection, measuring and transmission line transients. Analysis of different types of rotating machines and electronic power converters.

For the specialization track *Electronic and Computer Engineering*

- Knowledge in planning, management and control of research and development projects in modern enterprises, scientific organizations and services of a contemporary information society. Knowledge in integration of circuits, algorithms and software.
- Comprehension of systems based on analogue and digital circuits, computers, systems on a chip and the corresponding software. Comprehension of methods used in the development, design and realization of complex electronic systems.
- Application of measurement of physical quantities, their conversion into electrical signals and analogue and digital signal processing. Application of embedded systems and networks for processing, storage, transmission, analysis and display of information.
- Analysis of electronic circuits and networks, process monitoring and control, communication systems, instrumentation and intelligent systems.

For the specialization track *Electronics*

- Knowledge of the key aspects and concepts of electrical engineering, passive and active components, electronics, electronic circuits and systems. Knowledge of methods of electronic equipment development, design and manufacturing. Knowledge and understanding underlying principles of electro-acoustic transducers and influences of acoustic noise on the environment.
- Comprehension of analogue and digital electronic circuits and systems.
- Understanding of various design related terms: life cycle, reliability, heat transfer and electromagnetic compatibility on electronic circuits and system operation. Comprehension of acoustic parameters and their incorporation into communications.
- Application of electronic circuits and systems in electronic instrumentation, monitoring and control systems, electronic communication and information systems. Applications of electroacoustic in medicine.
- Application of electronic circuits and systems in electronic instrumentation, monitoring and control systems, electronic communication and information systems. Applications of electroacoustic in medicine.

For the specialization track *Wireless Communications*

- Knowledge of principles and concepts of electromagnetic wave generation, transmission, propagation and reception in the area of radio- and optical frequencies; knowledge of key aspect of multimedia (picture, sound and data) processing and transmission.
- Comprehension of communication system units; comprehension of wireless and optical networks and system architectures which apply the methods of picture, sound, and data processing and transmission.
- Application of components and circuits in multimedia systems, mobile wireless systems (public and private), communication systems and navigation systems.

- Analysis of electronic components and circuits, electronic equipment and measurements systems. Analysis of components of communication systems.

Bachelor’s programme Computing:

General outcomes

Knowledge and understanding of...

- Appropriate mathematical principles and techniques underlying computing, including linear algebra, calculus, combinatorics, discrete mathematics and graphs;
- The science principles underlying computer systems;
- The key aspects and concepts of computing including digital logic, programming, algorithms and data structures, communication systems, and information theory;
- The key aspects and concepts of electrical engineering including circuit and field theory, electronics, signals and systems;
- The branch of computing based on knowledge and understanding of fundamental principles taught in common, as well as some forefront of one of the branches focused on in specialization courses;
- The social, ethical, business and legal context of engineering.

Engineering analysis...

- The ability to apply gained knowledge and understanding in analysis of information technology and computing products, processes and methods;
- The ability to apply their knowledge and understanding to identify, formulate and solve engineering problems;
- The ability to detect and apply relevant analytic, modelling and programming methods.

Engineering design abilities...

- The ability to apply their knowledge and understanding to specify, develop and realize a design to meet defined and specified requirements;
- An understanding of design methodologies in computing, and an ability to use appropriate mathematical methods, programming techniques or information, and communication technology tools.

Investigation abilities..., see Bachelor’s programme Electrical Engineering and Information Technology.

Engineering practice..., see Bachelor’s programme Electrical Engineering and Information Technology.

Transferable skills..., see Bachelor’s programme Electrical Engineering and Information Technology.

For the specialization track *Computer Engineering* (“module” in the wording of FER)

- Ability to recognize, relate, define and memorize fundamental concepts of software and hardware aspects of computer systems.
- Comprehension and identification of software and hardware relationships and classification of presented solutions. Ability to review and discuss generic models of software engineering, architectural components of computer systems such as processor, memory, buses, and IO devices as well as embedded systems and their applications.
- Application of software architecture concepts to solve simple to moderate problems, write software applications in standard programming languages and demonstrate functionality of the solution.
- Capacity to analyze, examine and test design principles in open, distributed, dynamic, interactive information services and systems, mostly based on the Web and associated concepts, technologies, and protocols (REST, Web 2.0, RIA, SOA, HTTP, URI, MIME, sessions), client (DHTML , Flash) and server technologies (servlets, ASP, JSP), concepts (MVC, DHTML, AJAX) and languages (PHP, JavaScript, Java). Demonstration of understanding of organizational structure of computer system including both hardware and software components

For the specialization track *Computer Science*

- Knowledge in both scientific and engineering principles, theoretical analysis, and computing experience to provide students with solid foundation of the discipline. Knowledge in software design covering software development tools, different programming paradigms, software design patterns and operating systems, system integration, management and economics in engineering, sustainable development and commercial law. Ability to work as an individual under guidance and as a team member in industry, utility sector, and government institutions.
- Comprehension of computer systems as a whole. This understanding encompasses an appreciation for the structure of computer systems and the processes involved in their construction and analysis. Comprehension of computation structures spanning the entire range of topics from digital logic design, operating systems, programming languages, software design, to databases.
- Application of both new emerging and recurring themes to a broad range of applications maintaining the skills as the field evolves. Application of modern physics, electronics, combinatorics, probability, statistics, discrete mathematic, automata theory, formal grammars and languages, and information theory: (i) in construction of modern computer, embedded, intelligent, network, and interactive graphics systems; (ii) in design and implementation of algorithms, data structures, programming language translators, and artificial intelligence systems; and (iii) to handle pattern recognition, parallelism, concurrency, and distributed processes.
- Analysis of essential concepts, principles, and practices in the context of well-defined scenarios, showing judgment in the selection and application of tools and techniques.
- Analysis of computational complexity of computation structures based on selected performance measures and analysis of performance tradeoffs.

For the specialization track *Information Processing and Multimedia Systems*

- Knowledge in computer science foundations required for design of information processing and multimedia systems including software and hardware development. Knowledge of information processing foundations including methods and algorithms for signal, image, video, and text processing and multimedia system design.
- Comprehension of methods and systems for information processing and analysis of signals, images, video, text and other types of information. Comprehension of methods

for implementation, development and realization of systems for processing, storage, transmission, analysis and display of information.

- Application of computer science theory and signal, image and video processing principles for modelling and design of information processing and multimedia systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- Analysis of information processing problems and ability to identify and define the computing requirements appropriate to its solution. Analysis of computer-based information processing and multimedia systems

For the specialization track *Software Engineering*

- Knowledge in the field of information systems, computer science and management. Professional competencies in the field of programming, abstraction and conceptual skills in the field of computing. Knowledge of teamwork.
- Comprehension of software development lifecycle, programming paradigms, programming techniques and development tools and environments.
- Application of programming paradigms, techniques and tools on developing, integrating, testing and documenting of software components and database applications.
- Analysis of end user applications, focused on application and management of information technology helping to approve efficiency of operations in different kind of businesses. Selection of appropriate solutions for different platforms based on experience gathered on solving real life problems.

For the specialization track *Telecommunication and Informatics*

- Knowledge in design and implementation of networks, systems and services, especially identification, formulation and solution of intermediate engineering problems in the area of communication networks and information services. Knowledge in information representation, logic and languages for specification and modelling. Knowledge in software development process including modelling, implementation and testing.
- Comprehension of architecture and operation of telecommunication networks and systems. Comprehension of multimedia services including video and voice. Comprehension of computer architecture including roles of major components, their connectivity, assembly instruction sets, memory addressing, parallelism. Comprehension of programming language translation.
- Application of concepts, techniques and tools related to local area networks, public mobile networks, computer-telephony integration, network programming and virtual environments.
- Analysis of organisation of public and private networks and services. Analysis of concepts and architecture of World Wide Web.

<u>Master's programme Electrical and Information Technology</u>:

General outcomes

Knowledge and understanding of...

- Mathematics required for solving complex problems related to electrical engineering and information technology, including analysis, chaos theory, computational mathematics, differential equations and stability theory, Fourier analysis, graph theory, linear algebra, and stochastic processes;
- Scientific principles underlying electrical engineering and information technology, including laser physics, physics of materials, field theory, and quantum computers;

- In-depth knowledge and understanding of the theoretical background and principles of their branch of engineering and also of the wider context of engineering;
- Critical awareness of the forefront of their branch;
- The social, ethical, business, and legal context of engineering, as well as of information society development.

Engineering analysis abilities...

- The ability to solve problems related to electrical engineering and information technology that are unfamiliar, incompletely defined, and have mutually competing specifications, by using a systematic approach to problem identification, analysis, modelling and simulation, and the evaluation of appropriate methods;
- The ability to formulate and solve problems in new and emerging areas of their specialisation;
- The ability to use their knowledge and understanding to conceptualise engineering models, systems and processes;
- The ability to apply innovative methods in problem solving.

Engineering design abilities...

- The ability to use their knowledge and understanding to design solutions to unfamiliar problems, possibly involving other disciplines;
- The ability to use creativity to develop new and original ideas and methods;
- The ability to use their engineering judgement to work with complexity, technical uncertainty, and incomplete information using abstraction, decomposition, consistency checking, requirement elicitation and other techniques.

Research abilities

- The ability to identify, locate and obtain required data;
- The ability to design and conduct analytic, modelling, and experimental investigations;
- The ability to critically evaluate data and draw conclusions;
- The ability to investigate the application of new and emerging technologies in their branch of engineering.

Engineering practice...

- The ability to integrate knowledge from different branches, and handle complexity;
- Comprehensive understanding of applicable techniques and methods, and of their limitations;
- Knowledge of the non-technical implications of engineering practice.

Transferable skills...

- The ability to function effectively as an individual, as a member of a team, or as a team leader whose team may be composed of people from different disciplines and levels;
- The ability to use diverse methods to communicate effectively within the engineering community and with society at large at the national and the international level;
- An awareness of the health, safety, legal issues and responsibilities of engineering practice, the impact of engineering solutions within the context of the society and the

environment, and commitment to professional ethics and responsibility, as well as the norms of engineering practice;

- An aptitude of project management and business practices, such as risk and change management, and the ability to understand their limitations;
- The ability to recognize the need for further learning, and the ability to engage in independent, life-long learning.

Specialization track *Control Engineering and Automation* ("profile" in the wording of FER)

- Application of modeling and simulation, control algorithms, signal processing, sensors and actuators technologies, measurement, identification and estimation of physical quantities, and communication technologies in industrial processes, robotics, autonomous systems and automation.
- Analysis of problems appearing in industrial processes, robotics, autonomous systems and automation. Recognition of problems related to process engineering, robotics and automation that are unfamiliar, incompletely defined, or having mutually competing specifications. Identification of appropriate approaches for their solutions by using process engineering and information technology.
- Evaluation of control systems applied to industrial processes, robotics, autonomous systems and automation, supported by formal approach and established mathematical methods.

Specialization track *Electrial Engineering Systems and Technology*

- Application of novel electrical engineering and information technologies in a wide area of electrical engineering systems and technology based on a systematic approach to solving engineering tasks.
- Analysis of problems and obtain the knowledge and the achievements in electrotechnics, power electronics, digital technology, applied mechanics, electromechanical energy conversion, contemporary measurement techniques and means of transportation.
- Apply acquired knowledge on electrical drives, mechatronic systems, modelling and construction of power electronic systems, design methodologies and diagnostics of electrical machines and devices, contemporary measurement systems, intelligent sensors and actuators.
- Summarize knowledge of applied computer systems for real-time operation, signal acquisition and processing, industrial communication networks, and system control via internet.

Specialization track *Electric Power Engineering*

- Application of network calculation in power system analysis, state estimation, protection, optimization, maintenance, transmission and distribution networks planning, design and operation, spatial load forecasting and influences of renewables on power systems.
- Analysis of problems related to power system planning, design, maintenance and operation. Recognition of problems related to electrical power engineering and energy and environment management. Identification of appropriate approach for optimal solutions related to the energy use, with electrical engineering and information and communication technology. Analysis of electromagnetic transients in high voltage networks, power supply of electrical traction systems.
- Synthesis of elements for power system operation and control, including voltage and frequency dynamic behaviour and ancillary services. Synthesis of environmental and economic assessment models of different power generating strategies and electricity market issues. Integration of multidisciplinary knowledge to achieve solutions in a wide spectrum of applications.

- Synthesis of systems for conventional (including nuclear) and new renewable sources by using both deterministic and probabilistic reliability and safety analyses. Evaluation geographically distributed advanced information and SCADA systems supported by formal mathematical approach and established practical methods.

Specialization track *Electronic and Computer Engineering*

- Application of analogue, digital and mixed signal processing, image processing, speech processing, sensor technologies, electronic measurements, embedded systems and network technologies for acquisition, processing, storage, transmission, analysis and display of information.
- Analysis of problems appearing in industry, communications and health care. Recognition of problems related to electrical engineering and information technology that are unfamiliar, incompletely defined, or having mutually competing specifications. Identification of appropriate approach for its solving by using electrical engineering and information technology.
- Synthesis of systems for measurement and acquisition of physical quantities and their transform to electrical signals. Synthesis of systems for analogue and digital signal processing, including image and speech processing. Synthesis of embedded systems, networks and systems on chip, including hardware and software development. Synthesis of biomedical systems. Integration of multidisciplinary knowledge to achieve complete solutions in a wide spectrum of applications.
- Evaluation of electronic measurement systems, biomedical systems, process control systems as well as communication and intelligent systems, supported by formal approach and established mathematical methods.

Specialization track *Electronics*

- Application of analogue, digital and mixed signal integrated processing, microwave engineering, radio-frequency electronics and electronic measurements. Application of electroacoustic elements on the design of the audio systems and noise reduction.
- Analysis of the effects of technology scaling on semiconductor integrated electronic device, analysis of specific solutions in analogue, digital and mixed signal electronic circuits, recognition of problems related to microwave components and RF electronic circuits and to electronic measurements. Analysis and synthesis of components for audio signal transmission and storage.
- Design of new semiconductor devices, design of analogue, digital and mixed signal integrated circuits, design of electronic equipment power supplies, synthesis of electronic systems based on analogue and digital design, design of microwave components and RF electronic circuits, synthesis of systems for analogue and digital signal processing, synthesis of audiosystems.
- Evaluation of electronic measurement systems; microelectronic and nanoelecronic systems; optoelectronic, microwave and RF systems. Recognition and selection of technologies for analysis of electroacoustic problems.

<u>Master’s programme Computing</u>:

General outcomes

Knowledge and understanding of...

- Mathematics required for solving problems related to computing, using discrete mathematics, stochastic , and algorithms;

- Science principles underlying computing technology, including data structures, advanced algorithms, and numerical methods;
- In-depth knowledge and understanding of the principles of their branch of engineering and also of the wider context of engineering;
- The social, ethical, business, and legal context of engineering, as well as of information society development.

Engineering analysis abilities...

- Graduates of the Master level are able to solve medium to difficult engineering problems consistent with their level of knowledge and understanding, and which may involve considerations from outside their field of specialization. Throughout the problem analysis phase graduates are able to use a variety of methods, including mathematical analysis, computational modelling, or practical software experiments, and are able to recognize the importance of constraints imposed by society, health and safety requirements, and environmental and commercial issues. In particular, they have:
- The ability to solve problems by means of computer problems that are unfamiliar to them, that are incompletely defined, and that may have mutually competing specifications;
- The ability to formulate and solve problems in new and emerging areas of their specialisation;
- The ability to use their knowledge and understanding to conceptualize engineering models, systems, and processes;
- The ability to apply innovative methods in problem solving, based on discrete mathematics, nature inspired algorithms, and heuristics.

Engineering design abilities...

- The ability to use their knowledge and understanding to design solutions to unfamiliar problems, possibly involving other disciplines;
- The ability to use creativity to develop new and original ideas and methods;
- The ability to use their engineering judgment to work with complexity, technical uncertainty and incomplete information, using abstraction, decomposition, consistency checking, requirement elicitation, and other techniques.

Research abilities...

- The ability to identify, locate and obtain required data;
- The ability to design and conduct analytic formal modelling of computing systems and perform software experimental investigations;
- The ability to critically evaluate the results of modelling and empirical testing in order to draw conclusions;
- The ability to investigate the application of new and emerging technologies in the field of computing.

Engineering practice...

- The ability to integrate knowledge from different branches, and to handle complexity of present-day computing systems;

- Comprehensive understanding of applicable techniques and methods, and particularly of their limitations;
- Knowledge of the non-technical implications of computing systems practice.

Transferable skills..., see Master's degree programme Electrical and Information Technology.

For the specialization track *Computer Engineering* ("profile" in the wording of FER)

- Application of concepts, theories and practical aspects of the design and implementation of computers, computer based systems, mobile and embedded devices/computers, communication systems and other systems that incorporate computers as well as software design with emphasis on applications that require knowledge of the complete system.
- Capability to analyze, categorize and compare system based approach to the design of computers, communication system and software as a whole. Knowledge on how to provide and execute tests and criticize organizational structure and parts of the system.
- Knowledge required to design and develop software solutions to complex problems based on, among others, complex data structures, optimizations, HW/SW dependence, use of several programming languages and development platforms. Design of real-world computer applications and systems which are required to achieve the desired computer system properties: performance, price, power consumption and/or reliability.
- Evaluation of different design approaches and solutions available such as complex software solutions for large to mobile systems, ubiquitous and pervasive computing approaches, large systems integration approaches, software/hardware co-design solutions and multimedia architectures and systems. Knowledge required to envision, conceptualize and design innovative, from simple to complex computers, computer based systems and applications running on those platforms.

For the specialization track *Computer Science*

- Application of scientific and mathematical, as well as engineering and practical, knowledge in design and development of elementary ecosystems structures. Application of machine learning, data, knowledge and text mining, fuzzy, evolutionary and neuro-computing, computer modelling of physiological systems, computer vision, expert systems, neural networks, virtual environments, human-computer interaction, multimedia, computational mathematics, financial mathematics, nanoscience, quantum computing, service-oriented computing, networked systems middleware, intelligent multiagent systems, and multisensor systems in design and implementation of computation structures of cyber-physical, social computing and biomedical systems.
- Analysis of computing ecosystems and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society. Computer aided analysis of dependability, security and real-time requirements of different ecosystems platforms, like mobile, cloud and big data, by means of graph theory, complex analysis, mathematical chaos theory and stability theory.
- Synthesis of the most challenging computing ecosystems, from the low-level infrastructural system programming to high-level application design, as well as practical and project management solutions needed by the potential leaders of a group of programmers guiding them towards the most advanced problem solving paradigms. Synthesis of computation structures of cyber-physical, social computing and biomedical systems into complex computation structures that support design and implementation of sophisticated financial, health, transport, energy, education and geoinformation systems.
- Evaluation of complex computing ecosystems that transcends the implementation details of various components to encompass an appreciation for the complex structure of computing ecosystems and their predictive behaviour. Multidisciplinary evaluation of

technical and non-technical aspects supported by interactive simulation, operations research, heuristic optimization, risk management, mathematical methods covering extremal combinatorics, and formal methods covering mathematical logic and computability.

For the specialization track *Software Engineering and Information Systems*

- Application of systems analysis, design and restructuring to systems that include a human being as a user and a key subject. Application of advanced structured and object-oriented modelling, data warehouse modelling, and programming techniques. Application of the acquired knowledge about database systems and business intelligence. Application of project management techniques for planning, acquisition, development and implementation of complex information systems.
- Analysis of organizational context, organizational culture and organizational information needs. Information gathering and identification of business goals, and functional and system requirements. Analysis of problems to be solved by computer. Identification of stakeholders and prerequisites of successful project management. Determination of project scope. Selection of adequate systems development lifecycle.
- Synthesis of business systems, production systems and governmental systems. Selection of adequate system architecture. Selection of the best algorithms for known problems. Design of system components. Design of proprietary algorithms for unknown problems. Integration and testing of system components and enterprise applications.
- Evaluation of software development environments, application and enterprise frameworks, ERP packages, CASE tools and project management tools. Evaluation of legacy systems. Estimation of information systems feasibility and sustainability.

<u>Master's programme Information and Communication Technology</u>:

General outcomes

Knowledge and understanding of

- Mathematics required for solving complex problems related to information and communication technology, including analysis, chaos theory, computational mathematics, differential equations, and stability theory, Fourier analysis, graph theory, linear algebra, and stochastic processes;
- Science principles underlying information and communication technology, including laser physics, physics of materials, and quantum computers;
- In-depth knowledge and understanding of the theoretical background and principles required for solving engineering problems in the area of information processing, telecommunications and informatics and wireless technologies;
- Additional knowledge and understanding of the selected special topics in the areas of information processing, telecommunication and informatics, and wireless technologies;
- Critical awareness of the forefront of information and communication technology, including new information society technologies and high-tech research and development areas;
- The social, ethical, business and legal context of engineering, as well as information society development.

Engineering analysis abilities...

- The ability to solve problems related to information processing, telecommunication and informatics and wireless technologies by using systematic approach to problem identification, analysis, modelling, simulation, and evaluation. Underlying requirements may be unfamiliar, incompletely defined, and have mutually competing specifications;
- The ability to formulate and solve problems in new and emerging areas of their specialization;
- The ability to use knowledge and understanding to conceptualize engineering models, systems and processes in information and communication technology;
- The ability to apply innovative methods in problem solving.

Research abilities..., see Master's degree programme Electrical and Information Technology.

Engineering practice..., see Master's degree programme Electrical and Information Technology.

Transferable skills..., see Master's degree programme Electrical and Information Technology.

For the specialization track *Information Processing* ("profile" in the wording of FER)

- Application of information and communication technology principles and advanced algorithms for design of information processing and analysis systems. Application of signal, speech, image, video and text processing, pattern recognition, video communication and network technologies for acquisition, processing, analysis, storage, transmission, analysis and display of multimedia information. Application of design and development principles for construction of intelligent systems for information processing.
- Analysis of information processing, analysis, and security problems appearing in industry, traffic, communications, and health care and identification and definition of computing requirements appropriate to their solutions. Analysis of local and global impact of information processing on individuals, organizations, and society.
- Synthesis of information processing systems with applications in various areas including biomedicine, industry, traffic, and defense including software and hardware development. Design, implementation and evaluation of computer-based information processing system, process, component, or program to meet desired needs.

  Synthesis based on formal methods of mathematical theory and computer science theory with comprehension of tradeoffs involved in design choices.
- Evaluation of computer-based information processing systems such as multimedia systems, signal, image and speech processing systems, computer vision systems, communication systems, information retrieval systems, their components, and software. An understanding of professional, ethical, legal, security and social issues and responsibilities.

For the specialization track *Telecommunication and Informatics*

- Application of information theory and information network theory, switching algebra and automata theory, communication protocols, distributed systems, programming, specification and modelling languages, data processing and management, virtual environments, virtual and augmented reality, software agents and systems with learning capability for design and implementation of information and communication systems and services. Application of software engineering, project management and research and development management to development of systems and services oriented towards the telecommunications market.

- Analysis of problems appearing in communications and information systems. Recognition of problems related to telecommunications and information technology that are unfamiliar, incompletely defined or having mutually competing specifications. Identification of appropriate approach for their solving using telecommunications and information technology.
- Synthesis of local, access, and core networks, including multi-service, intelligent, broadband networks, mobile networks and Internet, as well as planning and optimization of networks and information flows, and network management. Synthesis of software products for networks and services in telecommunication industry. Synthesis of software agent systems. Synthesis of systems for mobility in networks and mobile services. Synthesis of systems for information transmission and routing, including photonic technology. Synthesis of multimedia communication systems and services. Synthesis of systems for telematic services. Synthesis of virtual environments, virtual and augmented reality systems.
- Evaluation of e-business concepts in general and telecommunications market in particular. Planning, implementation, testing and management of public fixed and mobile telecommunication networks, Internet and related services. Design and operation of corporate and private networks and associated information systems and e-business systems with information rich contents.

For the specialization track *Wireless Technology*

- Design and planning of wireless and optical networks and systems (mobile communication networks, optical networks, broadcasting systems, terrestrial and satellite communication systems, wireless access, metropolitan and local networks, navigation and radar systems).
- Application of microwave engineering, radio-frequency electronics, optoelectronics; application of analogue, digital and mixed signal integrated processing. Solving the electromagnetic compatibility problems.
- Analysis and design of components for electromagnetic wave generation, transmission, propagation and reception in the area of radio- and optical frequencies; design of components for multimedia (picture, sound and data) processing and transmission.
- Evaluation of measurement systems (for multimedia, wireless, high-frequency and optical systems), multimedia systems, RF and microwave electronic systems and optoelectronic systems.

Analysis of Peers:

Generally, it is commendable that the FER meticulously aims at defining qualification profiles for completion of the resp. study programmes, and in particular for graduation in the different spezialisation tracks of the degree programmes to be considered here.

Otherwise, it is very much to the detriment of the documentation of these qualification profiles, at least with regard to the specialization tracks in the Bachelor's and Master's programmes ("modules" resp. "profiles"), that the so called objectives matrices hardly demonstrate to what extent and in which way the formulated learning outcomes at programme level are carried through in the curriculum (i.e. on the module level). In addition, as the programme coordinators admitted to during the audit talks, the specialization tracks in the Bachelor's programmes differ in subject specific courses with roughly 30 ECTS credit points only, thus even more highlighting their underlying affinity. Regarding the Master's programmes, the heterogeneity of the corresponding specialization tracks seem to be much more obvious given their broad array of optional courses to be individually selected out of different disciplinary specific course catalogues. Due to this fact, it seems all the more necessary that the HEI plausibly demonstrates how specialization tracks, deeply affiliated by conception, form part of Bachelor's and Master's programmes that aren't supposed to represent just *formally* separated entities.

And there is just another distinctive feature adding to this: Some specialization tracks of the Bachelor's programmes are not continued in the correspondent Master's programme, as one would suggest: e.g. the specialization wireless communication in the Bachelor's programme Electrical Engineering and Information Technology is not continued in the consecutive Master's programme but in the Master's programme Information and Communication Technology (specialization in wireless communication technologies); the specialization information processes and multimedia technologies in the Bachelor's programme Computing isn't continued in the consecutive Master's programme but in the Master's programme Information and Communication Technology as well; the spezialication electronic and computer engineering in the Bachelor's programme Electrical Engineering and Information Technology is continued not only in the correspondent Master's programme (specialization of the same name) but also in the Master's programme Computing ("profile" computer engineering). To be sure, this observation does not question the coherence and consistence of programme conception and structure principally, it may be reasonable and (more or less) well founded. Obviously, it partly relates to the institutional and disciplinary history of the Faculty and, partly, might be attributed to a flexible response of the FER to market demands (companies' needs and student request being intermingled), as some indications of programme coordinators suggested.

Be that as it may, these differences of the programmes and specialization tracks need to be identifiable to all stakeholders (students and applicants of the resp. programmes in the first place), and their implementation into the curricular conception of these programmes needs to be comprehensible. Unfortunatedly, the matrices, which should have illustrated this, do not refer to the module level ("module" in terms of the familiar Bologna-related meaning of study package; "courses" in the terminology of the SAR). As a result, one cannot derive from the matrizes the conclusion that the FER has done its homework properly but has to carefully check whether the course content of every single specialization track reflects the qualification profile sought. Nevertheless, this deficit in large part seems to pose a problem of illustration or demonstration and is not or at any rate not primarily a problem of curricular structure or content.

Finally, it should be noticed that the definition of learning outcomes for the study programmes appear way too long to be used for example as succinct information on the academic and professional qualifications of graduates in the Diploma Supplement. A short and yet precise description of achieved qualifications as part of the Diploma Supplement helps stakeholders like other HEIs or business/industry companies in finding out whether applicants match the requirements for concrete job offers (see below chapter B-7.2).

Assessement of Peers; ASIIN-Criterion 2.2:

The peers evaluate the requirements of the criterion as not sufficiently fulfilled yet. They find it indispensible that the name of the study programme, the name of specialization track ("module" or "profile"), and the corresponding learning outcomes (in terms of qualification profiles) as well as the study content have to be made consonant with each other. Their coherence must be plausibly demonstrated in the goal matrix for each programme. Furthermore, study aims and intended learning outcomes must be made accessible to the relevant stakeholders, in particular students and lecturers, in such way that students are able to appeal to them (for example in the course of internal quality assurance processes).

Assessment for the award of the EUR-ACE® Label for the Bachelor's and the Master's programme Electrical Engineering and Information Technology and the Master's programme Information and Communication Technology:

The deficits in strictly illustrating how the defined learning outcomes are implemented in the curriculum notwithstanding, the peers deem the intended learning outcomes of the said degree programmes fully complying with the engineering specific part of Subject-Specific Criteria of the Technical Committee 02 – Electrical Engineering and Information Technology (see for further assessment below chapter B-2.6).

Assessment for the award of the Euro-Inf Label® for the Bachelor's and the Master's programme Computing:

The deficits in strictly illustrating how the defined learning outcomes are implemented in the curriculum notwithstanding, the peers deem the intended learning outcomes of the said degree programmes principally complying with the Subject-Specific Criteria of the Technical Committee 04 – Informatics/Computer Science (see for further assessment and reservation concerning the Bachelor's programme Computing below chapter B-2.6).

B-2.3 Learning outcomes of the modules/module objectives

The objectives of the individual modules (i. e. "courses" in the wording of the HEI) are described in a data base. The module descriptions are available to students on the website.

Analysis of Peers:

In general, the module descriptions are informative and precise. In particular, the learning outcomes are described sufficiently and transparently, thereby yielding a sound basis for the assessment of the students' and graduates' knowledge, skills and competencies. The stated objectives and learning outcomes provided a reference for the evaluation of the programmes' curricula and resources.

In addition, it could be stated that the descriptions (and other relevant study information) are available electronically to students, teachers and other interested parties.

Assessement of Peers; ASIIN-Criterion 2.3:

The peers conclude that the requirements of the criterion have been approached adequately. Nonetheless, they encourage programme coordinators and teaching staff alike to maintain and further work on the quality of the module (course) descriptions.

B-2.4 Job market perspectives and practical relevance

The HEI mentions the following job perspectives for the graduates:

For the Bachelor's and Master's programme Electrical Engineering and Information Technology

- Continuous and even growing demand of experts in all fieds of electrical engineering and information technology, in particular those interdisciplinary areas of information technology – broadly defined to include computers, data networks and communication systems, as well as the supporting technologies required to sense, process, store and display information – which have come to have a dominating influence on electrical engineering;
- Partly close ties and manifold cooperations with companies in the field of electrical engineering and information technology like Končar d.d., Zagreb, Hrvatske željeznice (Croatian Railway), ABB, Zagreb, Ericsson Nikola Tesla, Zagreb, Siemens, Zagreb, small and medium enterprises, Croatian Telecoms as well as many other service companies which are dealing with EE and IT;
- According to the SAR, important job market segments are educational, academic and research positions, as well as positions in the state agencies, offices and ministries in the area of science, technology, education, communications, health, economy, and others, involved in information society development;
- Master's programme: specialization track *Control Engineering and Automation* qualifiying for: automation in industry; robotized systems in industry; services and households; control of moving objects; distributed and remote control; data acquisition and analysis; real time computer systems; electronic equipment and hardware for measurement; control and communication; specialization track *Electrical Power Engineering* qualifying for: planning and design of electrical installations; distribution and transmission networks and conventional and nuclear power plants; design, construction and maintenance of electric power equipment; development, maintenance and inspection of power subsystems; control and maintenance of bulk power systems operation; planning and control of miscellaneous/different/various energy systems; solving problems of energy supply in urban areas and industries; managing projects in financial institutions; power market and exchange institutions; educational and research and development institutions; specialization track *Electrical Engineering Systems and Technology* qualifying for: development, design and construction of electrotechnical components, devices and systems, in all branches of industry, in small and mid-size enterprise, and research and development institutes. For instance, the jobs like research, development, design, construction, manufacture and modernization of industrial plants, transportation and energetics, especially automation of ecological plants and design of flexible production lines, highly skilled jobs in institutions of quality control, in military and other specialist professions; specialization track *Electronic and Computer Engineering* training for: planning, realization, leading and supervision of R&D projects in modern economy, as well as in universities, research institutes and IT providers; specialization track *Electronics* training for: development, production and maintenance of any advanced system, e.g. in electrical engineering, computer engineering and informatics, includes the teamwork where the experts in electronics are needed. The electronics engineers can be employed in electrical engineering, electronics, communication industry, mechanical industry, petrochemical industry, food industry, public companies and SME, and consulting companies.

For the Bachelor's and Master's programme Computing

- Cooperations with industry, research centres and enterprises on technology transfer projects building job opportunities for graduates (bachelor and master level);

- Demand for graduates in all fields of computing applications involving networking, programming, analysis and design, database systems, computing support, and general knowledge of information technology; concluding from this, the SAR states job perpectives in a wide variety of businesses, including public and private industries, banks, insurance companies, software developers, government agencies, and hospitals.
- Master's programme: researcher training as central aim of the programme; programme aiming at the researcher demands of higher education institutions, information technology industry, the society and government; specialization track *Software Engineering and Information System* qualifying for a large number of fields of work, including software engineering and architecture, information systems analysis, design, development, implementation and maintenance, knowledge engineering, web design, software engineering and information system consultancy, as well as in the field of education and research; specialization track *Computer Engineering* leading to work in all environments where computing skills are required, together with knowledge of communication, embedded systems and other systems containing computers; specialization track *Computer Science* permitting graduates to quickly adapt to new technologies and ideas in the areas of designing and implementing software (industry, e-government and financial institutions), innovations in computing technologies (entrepreneurial activity) and developing effective ways to solve computing problems (research positions at universities and R&D laboratories).

For the Master's programme Information and Communication Technology

- Generally: research and academic positions and cross disciplinary innovation; positions related to information and communication system design and software development; development and implementation of large scale information and communication systems and networks, working in teams, and producing products and services that meet customer needs; positions in organizations interested in technology primarily as a vehicle to meet their needs; career that features a mix of technical and business issues in a variety of organizations and settings.
- According to the SAR, job market for the specialization track *Information and Communication Technology* includes large companies Ericsson Nikola Tesla, Zagreb and Siemens, Zagreb, small and medium enterprises, telecom operators with significant market power HT - Hrvatski Telekom (Croatian Telecom), T-Mobile Hrvatska and VIPnet, as well as many service providers and alternative operators; job market segments are educational, academic and research positions, as well as positions in the state agencies, offices and ministries in the area of science, technology, education, communications, health, economy, and others, involved in information society development.
- According to the SAR, graduates with the specialization track *Information Processing* should find job opportunities in large telecom companies such as Ericsson Nikola Tesla and Siemens, but also a variety of smaller companies, developing custom solutions for information systems consisting of subsystems for transfer, storage, processing, and analysis of information. As typical application areas, as identified by the HEI, the SAR registers digital and analogue instrumentation and measurement equipment; biomedical applications with systems for biomedical signal and image processing, analysis, and visualization; speech signal processing and analysis; systems for analogue signal processing; digital hardware for information processing; microprocessor and microcontroller systems.
- Job opportunities for graduates of the specialization track *Telecommunications and Informatics* are primarily seen in two broad areas: communication network design, and information and communication software development, including Web media, services and content.
- Graduates with the specialization track *Wireless Technologies* should, according to the SAR, mainly be prepared to work in the in development or research. Potential employers

include big companies such as Ericsson Nikola Tesla and Siemens but also a large number of small and medium sized businesses.

Practical relevance of the programmes shall be achieved by:

- Bachelor‘s programmes: laboratory exercises, field education in terms of educational visits to the companies where students should learn about the application of the acquired knowledge, project, bachelor thesis (no industrial placement).

- Master’s programmes: laboratory exercises, project, and graduation thesis (optional: internship).

Analysis of Peers:

The job perspectives in the fields of the said degree programmes are good, which partly may be due to the apparently close links of the FER to companies in the region and abroad.

In accordance with that, the current integration of practical elements into the curriculum of the study programmes under consideration seems to be suitable to prepare students for handling tasks and problems in their future work positions. Otherwise, programme coordinators, teaching staff and students consonantly agree to the impression of a certain disregard of the Bachelor degree in companies and public sector institutions as well. May this be due to a lack of knowledge or to manifest doubts whether bachelor graduates dispose of professional competencies sufficiently, it certainly raises the awareness for all parts of study directly linked to professional practice. In this respect, apart from laboratory exercises, field education and projects, an industrial placement as an obligatory element of the curriculum bears vital importance for acquiring fundamental competencies needed in professional work environments. Yet, while such an Industrial Internsphip is integrated as on optional element in the Master’s programmes, it is altogether left out of the curriculum of the Bachelor’s pogrammes. Experience has shown that in the Electrical Engineering and Information Technology field at least, industrial internships contribute significantly to students’ ability to individually and responsibly conduct profession- and subject-related tasks in a company.

Assessement of Peers; ASIIN criterion 2.4:

The peers conclude that the requirements of the above mentioned criterion are met sufficienctly. Though, with view to the Bachelor’s programme Electrical Engineering and Information Technology they recommend implementing a mandatory Industrial Placement for all students in order to improve their ability to individually and responsibly conduct profession- and subject-related tasks in a company.

B-2.5 Admissions and entry requirements

Bachelor’s programmes

Article 19 “Regulations of the University Undergraduate and Graduate Studies...” stipulates the following entry requirements:

- “(1) A person who has completed a secondary school in duration of at least four years and who fulfils additional prerequisites prescribed by the Faculty council is allowed for admission to an undergraduate study at the Faculty. [...]”

Prerequisite for enrolment in an undergraduate programme at Faculty of Electrical Engineering and Computing (FER) are following State Matura exams:

- Croatian language – A or B level
- Mathematics – A level
- Foreign language – A or B level.

Ranked list of candidates for enrolment in first year of Bachelor study program at Faculty of Electrical Engineering and Computing will be prepared by following criteria:

- according to success in secondary school education - up to 400 points
    - up to 80 points for each of the four years of secondary school education depending of the average grade (maximum is 4×80=320)
    - up to 80 points depending of the average grade of compulsory State Matura exams.
- according to results at State Matura:
    - Mathematics (A level) up to 360 points
    - Physics up to 240 points
    - Necessary condition for enrolment is that the sum of achieved grades of State Matura exams in Mathematics (A level) and Physics is 7 at least (out of 10).
- special achievements – direct enrolment (1000 points):
    - first three places winners in state contest in Croatia in the fields of Mathematics, Physics or Informatics (category Pascal/C) during third or fourth year of secondary education
    - participation in Olympiads in Mathematics, Physics or Informatics

All parameters for scoring are translated into points according to the following simple linear transformation: Number of points = score / maximum possible score x maximum possible number of points.

<u>Master’s programmes</u>

Article 19 “Regulations of the University Undergraduate and Graduate Studies...” stipulates the following entry requirements:

- “(2) A person who has completed an adequate undergraduate study earning at least 180 ECTS credits and who fulfils additional prerequisites prescribed by the Faculty council is allowed for admission to a graduate study at the Faculty.
- (3) Undergraduate studies adequate for admission to graduate study are:
    - electrical engineering and information technology,
    - computing or
    - undergraduate programmes in area of technical sciences, natural sciences and other
    - similar areas.“

Requirements for enrolment in a graduate programme at FER:

Candidate can earn up to 1000 points in admission procedure:

- up to 600 points can be earned on entrance exam,
- up to 400 points can be assigned to each candidate according to duration of previously finished bachelor program and grade average.
- Points based on success at bachelor level are calculated as follows: B = P × 400/5 (where: P = grade average (maximum 5.00))

Students who have obtained bachelor degree at FER, at any other internationally accredited university or partner university, and who have finished the studies in a maximum of 4 years (8 semesters) are exempt from the entrance exam. A maximum of 600 points in the category of entrance exam is automatically assigned to them.

All other students are obligated to take an *entrance exam* in courses common for Bachelor study program in Electrical Engineering and Information Technology and Bachelor study program in Computing.

- Entrance exam consists of 30 problems.
- Each correctly solved problem adds 20 credits to candidate's score;
- Each wrongly solved problem subtracts 6 credits from the candidate's score;
- An unanswered problem results with 0 credits.
- Duration of Entrance exam is 3 hours (180 minutes).

According to the SAR (National Accreditation), recognition of foreign higher education qualifications is based on the following documents:

- The law of the recognition of foreign education qualifications. In Croatian: Zakon o priznavanju inozemnih obrazovnih kvalifikacija (NN 158/2003, 198/2003, 138/2006)
- Criteria for the evaluation of the foreign higher education qualifications. In Crioatian: Kriteriji za vrednovanje inozemnih visokoškolskih kvalifikacija (AZVO, klasa: 602-06/08-01/52, ur.broj: 335-05-08-01, od 9. travnja 2008.)
- Lisboa convention (Convention of recognition of higher education qualifications in Europe), 1997 (European Council contract No. 165)
- The law of the confirmation of the Convention of recognition of higher education qualifications in Europe. In Croatian: Zakon o potvrđivanju Konvencije o priznavanju visokoškolskih kvalifikacija u području Europe (Narodne novine, Međunarodni ugovori, br: 9/2002 i 15/2002)
- The law of the scientific activity and higher education. In Croatian: Zakon o znanstvenoj djelatnosti i visokom obrazovanju (NN 123/03, 198/03, 105/04 i 174/04)

Academic recognition, i.e. *recognition of the international higher education qualification* for the purpose of continuing the education at the Faculties of the University of Zagreb is said to be carried out by the Office for the academic recognition of the international higher education qualification of the University of Zagreb according to the regulations mentioned above. *Recognition of a period of studying at the Faculty of Electrical Engineering and Computing* is carried out by the Committee for the recognition of a period of studying spent at the international higher education institution, which is formed by the dean on purpose, thereby taking into account the level of each course and its structure as well as the acquired knowledge and competencies.

Recognition of the acquired competencies through the non-formal and informal education is said to be awarded after the student application and according to the attached documents of the acquired knowledge and competencies and ECTS credits. ECTS coordinators in collaboration with a Vice Dean for education and a Vice Dean for research are in charge of recognitions at the Faculty of Electrical Engineering and Computing.

Analysis of Peers:

The applicable admission requirements are transparent and accessible to all stakeholders involved, and they seem to be strictly applied. Not least the generally high graduation record within the standard period of study seems to confirm that the admission requirements positively correspond with the achievement of learning outcomes and, more generally, of the quality objectives pursued at the FER.

As the FER's list of instruments and offers for counselling and advice of students and applicants show (see below chapter B-3.3) and audit discussions confirm, the Faculty strives to identify from the outset students' or applicants' competencies and shortcomings with regard to the elected study programme. Obviously, these measures do not only aim at identifying students' capabilities for commencing a programme but also to provide appropriate support for improving the learning process.

Existing regulations concerning the recognition of activities completed externally appear to be in accordance with ASIIN requirements and chapter III of the Lisbon Convention.

Assessement of Peers; ASIIN-Criterion 2.5:

The peers judge the said criterion as being addressed adequately. With regard to the recognition of activities completed at other HEIs or at institutions/learning environments other than HEIs they assume that the FER proceeds in accordance with the formal and procedural setting as described in its SAR.

B-2.6 Curriculum/content

Curriculum of the Bachelor's programme Electrical Engineering and Information Technology:

Within the study program of Electrical Engineering and Information Technology, a student can slightly specialize in one among several offered specializations (through selecting an appropriate group of courses during the third year of study).

Specialization track ("module") Control Engineering and Automation

Control Engineering and Automation as multidisciplinary technological and engineering fields comprise the following knowledge: determination of requirements and criteria for control systems design related to flow of matter, energy and information; implementation of methods for information processing and data acquisition in the control and automation systems; implementation of methods for system analysis and design; design and implementation of hardware and software for control and automation systems.

Specialization track Electrical Power Engineering

Electrical Power Engineering covers electric power system components, electricity consumption, generation (thermo, hydro, nuclear, renewable), transmission, distribution, electric utility operation, electric power system control, power system protection, power system reliability, government regulation, market operations, risk management etc.

Specialization track Electronic and Computer Engineering

Electronic and computer engineering covers a knowledge base in electronic circuits, process monitoring and control, communications, instrumentation and intelligent systems. It comprises measurement of physical quantities, their conversion into electrical signals, analogue and digital processing, application of embedded systems and networks for processing, storage, transmission, analysis and display of information. The emphasis of the programme specialisation lies within an integration of multidisciplinary knowledge on circuits, algorithms and software in order to enable students to solve sophisticated problems in planning, management and control of research and development projects in modern enterprises, scientific organizations and services of a contemporary information society.

Specialization track Electronics

Electronics encompasses analysis, design and implementation of electronic systems that contain electronic devices and electronic circuits. The specialization focuses on theoretical and practical knowledge needed for modelling, simulation, design and production of electronic circuits and systems in the fields of microelectronics, radiofrequency and microwave electronics, power electronics, electroacoustics, audio electronics, biomedicine, electronic measurement and testing, as well as other areas in electronics.

Specialization track Wireless Communications

This specialization is based on electromagnetism as essential wireless communication tool and on widely applied radio systems. Principal topics are: electromagnetic wave properties, propagation, wireless communication phenomenon, basic communication system units, signal processing for communication purposes, mobile wireless systems (public and private), optical communication technologies, multimedia and radio navigation, and wireless systems applications.

The study programme is to be completed with a bachelor thesis in the third study year.

Curriculum of the Bachelor's programme Computing:

Within the study program of Computing, a student also can slightly specialize in one among several offered tracks (through selecting an appropriate group of courses during the third year of study).

Specialization track Computer Engineering

Computer engineering includes theory and practical aspects of the design and implementation of computers, computer based systems, mobile and embedded computers, communication systems and other systems that incorporate computers as well as software design with emphasis on applications that provide knowledge and understanding of the complete system. The Computer engineering specialization provides a system based approach to the design of computers and software as a whole. It offers a combination of core and advanced knowledge from both computing and electrical engineering required to understand, to design and to be able to envision future complex computers, computer based systems and applications running on those platforms.

Specialization track Computer Science

The *computer science specialization* encompasses an appreciation for the structure of computer systems and the processes involved in their construction and analysis.

Specialization track Information Procession and Multimedia Systems

The study profile provides knowledge in hardware and software components for processing, storage, coding, transfer, and analysis of various types of multimedia information (signals, speech, data, images, and video).

Specialization track Software Engineering

The curriculum of this specialization combines theoretical knowledge with practical work and experience, developing professional competencies in the field of programming, abstraction and conceptual skills in the field of computing. It provides multidisciplinary knowledge in the field of information systems, computer science and management. Focused on application and management of information technology helping to approve efficiency of operations in different kind of businesses, it aims to unite technological knowledge with organizational environments.

Specialization track Telecommunication and Informatics

The Specialization track *Telecommunication and Informatics* encompasses, besides general computing topics, information representation, logic and languages for specification and modelling, as well as architecture of telecommunication networks and systems, and multimedia services. Elective courses cover concepts, techniques and tools related to local area networks, public mobile network, computer-telephony integration, network programming, basics of virtual environments and others, that will give qualifications and capabilities for development, production and usage of new information and communication technology.

Both study programmes require conducting a bachelor thesis in the third study year.

Curriculum of the Master's programme Electrical Engineering and Information Technology:

Within the study program, a student immediately has to decide for a certain specialization track. This will determine the list of theoretical and specialization courses to choose from.

Specialization track Control Engineering and Automation

Control Engineering and Automation as a multidisciplinary scientific and technological field comprises the following knowledge: determination of requirements and criteria for control systems design related to flow of matter, energy and information; research, development and implementation of methods for information processing and data acquisition in the control systems; research, development and implementation of methods for the system analysis, the system design and the system optimization; development, design and implementation of hardware and software for computer control of systems; research, development and design of control algorithms for robots and robotized systems in industry, services and households.

Specialization track Electrical Systems and Technology

The specialization track *Electrical Engineering Systems and Technology* is based on a systematic approach comprising the knowledge and the achievements in electrical engineering, power electronics, digital technology, applied mechanics, electromechanical energy conversion, contemporary measurement techniques and means of transportation. The topics on electrical drives, mechatronic systems, modelling and construction of power electronic systems, design methodologies and diagnostics of electrical machines and devices, contemporary measurement systems, intelligent sensors and actuators are studied in detail. The multidisciplinary character of the specialization track includes the knowledge of applied computer systems for real-time operation, signal acquisition and processing, industrial communication networks, and system control via Internet.

Specialization track Electrical Power Engineering

Electrical Power Engineering encompasses knowledge of fundamentals and applications of electrical power engineering in a wide range of topics: theory of power systems control; optimization methods applied to power systems; energy efficiency methods; reactive power control; electric facilities automation; reliability theory; expert systems; environmental protection; efficient use of energy and energy conservation; economic analysis; disturbances and transient phenomena in power systems; power system protection; transmission and distribution networks network planning; development, stability, availability, reliability and operational safety of electric power system subsystems; mathematical modelling of power plants components and subsystems; deterministic and reliability analysis of operational safety; development modelling and analysis of environmental impact of electric power systems; establishment of open market environment, risk management and electrical energy trading; economy modelling, business and human resources management ,microeconomics, marketing, etc. Besides education, research is a crucial factor determining the power systems engineering progress with emphasis on the development of new power system technologies.

Specialization track Electronic and Computer Engineering

Electronic and Computer Engineering covers measurement and acquisition of physical quantities, transform to electrical signals, analogue and digital preprocessing, embedded system and networks for digital signal processing, transmission, analysis, storage and display of data. It gives strong emphasis on integration of multidisciplinary knowledge, as well as hardware, algorithms and software design to achieve complete solutions in a wide spectrum of applications.

Specialization track Electronics

Electronics encompasses knowledge in the field of micro- and nanoelectronics, radiofrequency and microwave electronics, optoelectronics, power electronics, audioelectronics, electro-acoustics, architectural acoustics, ultrasound, biomedicine, electronic measurement and testing, as well as other areas in electronics.

Curriculum of the Master's programme Computing:

Within the study program, a student immediately decides for one of the following subject specific tracks. This determines the list of theoretical and specialization courses to choose from.

Specialization track Computer Engineering

Computer Engineering program covers knowledge of theory and practical aspects of the design and implementation of computers, computer based systems, mobile and embedded devices/computers, communication systems and other systems that incorporate computers as well as software design with emphasis on applications that require knowledge of the complete system. It provides a system based approach to the design of computers, communication system and software as a whole.

Specialization track Computer Science

Computer Science aims at the study of computers and algorithmic processes, including their principles, their hardware and software designs, and their applications. According to the SAR, the specialization track integrates scientific and mathematical, as well as practical, dimensions into a distinct program study. Understanding of this integration is said to transcend the implementation details of various components to encompass an appreciation for the complex structure of computer systems and their predictive behaviour.

Specialization track Software Engineering and Information Systems

The specialization track focuses on the analysis and evaluation, specification, design and development of software products. Information systems are focused on using computer hardware, communication and software technology, thereby delivering the technical, mathematical and other interdisciplinary knowledge. Such systems might be business systems, production or governmental systems.

Curriculum of the Master's programme Information and Communication Technology:

Within the study program, a student immediately decides for a spezialization. This determines the list of theoretical and specialization courses to choose from.

Specialization track Information Processing

The Information processing track includes hardware and software components for processing, storage, coding, transfer, and analysis of various types of information (signals, speech, data, images, video). It covers knowledge in theory and applications of communications, compression techniques, information security, and real-time signal processing.

Specialization track Telecommunications and Informatics

The specialization track focuses on the analysis and synthesis of multimedia information and communication in networks, as well as design and implementation of various communication systems and services. Models of local, access, and core networks are studied, including multi-service, intelligent, broadband networks and Internet, as well as planning and optimization of networks and information flows, and network management. Information transmission and routing, including photonic technology, are studied, as well as information and communication services, manageable, and testable systems and networks structures with adequate performance. Students should acquire knowledge in the areas of distributed systems, programming, specification and modelling languages, data processing and management in networked systems, telematic services, e-business, and systems with learning capability. Related to that communication protocols, multimedia communications, virtual reality and virtual environments, mobility in networks, mobile networks and software agents are studied.

Specialization track Wireless Technologies

Wireless Technologies comprise the scientific and professional area related to the principles of electromagnetic waves generation, transmission, propagation and reception in the area of radio- and optical frequencies; devices and software characteristics and design for the above mentioned purposes; wireless and optical networks and systems architecture which apply the methods of sound, picture and data processing and transmission; electromagnetic compatibility; wireless networks and systems planning and design (mobile communication networks, optical networks, broadcasting systems, terrestrial and satellite communication systems, wireless access, metropolitan, local networks, navigation and radar systems.

Analysis of Peers:

All in all, learning outcomes are reflected in the respective course content and it can be derived from that, in general, that they will be achieved by students. Principally, the same is true for the internal adjustment and coordination of the modules/courses.

Three topics have been intensively discussed at the FER: firstly, the structure of the study programmes in general, secondly, the multiple specialisations in each programme under consideration, and thirdly, the underlying concept of the Computing programmes, in particular the Bachelor's programme of Computing.

1) The diversity of programmes which are closely related and strongly intertwined is, of course, noticeable at FER. This holds true even more so for the numerous specialisations in the Bachelor's as well as in the Master's programmes. For the Bachelor's programmes at least, which are normally designed to lay the scienctific and engineering foundations and to make students aquainted with the different subject specific areas of expertise, it is not usual to focus students' interest on specialties of the discipline at this stage of their academic education. According to the programme coordinators, this strategy has been adopted primarily in order to meet requirements of the job market, more or less openly claimed by business or industry companies. Otherwise, the effects of this decision apparently remain to be contested within the Faculty and teaching staff of FER. It has been the aim to strengthen the employability of graduates by tailoring the Bachelor's programmes along the specific demands of industry and business. But the net effect of that conceptual strategy has been judged disputable, thus forcing programme coordinators and teaching staff to consider establishing only two pure undergraduate programms in Electrical Engineering and Information Technology resp. Computing in the medium term, thereby enabling even deeper disciplinary specialisations in the Master's programmes.

2) At present, programme coordinators conceded that the specialisations in the Bachelor's programmes not always find their continuation in the formally consecutive Master's programme one would expect (i.e. that of the same name; see above chapter B-2.2) but in another Master's programme. This has been largely explained with specialization preferences of Bachelor graduates of the Computing programme, and in that sense as a purely technical device. Any misunderstanding on the students' side is said to be effectively avoided through the first study year which is essentially the same for students of both Bachelor's programmes, and through FERs constant advising and counselling during the study progress, in particular with regard to the election of specializations in the Bachelor's and Master's programmes.

3) The identical curriculum for the first study year in both Bachelor's programmes raises the question whether the wide ranging, engineering related basic training suits the needs of Bachelor students in different programmes equally well. Programme coordinators pointed out that a broad and fundamental engineering education in the early stages of the Bachelor's programmes has been exactly aimed at by curriculum planners. Essentially, this would suit a more hardware oriented tradition in computing education at the FER (*computer engineering* in combination with computer science). That way, teaching physics courses instead of deepening Informatics/Computer Science related fundamentals and core subjects (like Discrete Mathematics, formal methods, programming, modelling, software systems, software enginee-ring) is accepted though intensively discussed among the teaching staff, particularly as far as lecturers in the Computing programmes are concerned. Students vividly shared the view that the common engineering education in the two Bachelor's programmes go at the expense of a more specific designed curriculum in the Informatics area. Taking into account what has been previously noted about changes in the programme structure at the undergraduate level that are

already discussed or even under way, these alterations (implementing two distinct Bachelor's programmes, one in the Electrical Engineering and another in the Computing field) might prove just as well as possible solutions of the problem addressed here. But until then, shortcomings in the field of mathematics and natural sciences related to computing in a narrower sense remain to be stated in the Bachelor's programme Computing.

As to the elective and, particularly, "Skills" courses the FER representatives make it clear that these courses are awarded ECTS credits additionally (i.e. outside the regular 180 ECTS resp. 120 ECTS framework for Bachelor's and Master's programmes), and by the same token are listed in the Certificate and Diploma Supplement, but do not form part of the final grading.

Assessement of Peers; ASIIN-Criterion 2.6:

The peers deem the requirements of this criterion being fulfilled to a large extent, but not sufficiently yet for the Bachelor's programme Computing. They appreciate internal discussions on and approaches to structural modifications in the Bachelor's programme Computing in particular, as outlined by programme coordinators. In the short run though, they deem it necessary to adjust the curriculum of the Bachlor's Programme Computing in such a way that students achieve more competencies in the fundamentals of Informatics and related basics (like Discrete Mathematics, formal methods, modelling etc.) at the intended level. This might be accomplished for example by reducing contents of lesser importance for the programme (as for instance Physics or Higher Analysis).

Furthermore, the peers question the allocation of credits to the non-academic Skills courses like Chess, Bridge etc. However understandable those courses may be in view of motivational and social considerations, their awarding of credits seems disputable. The peers therefore recommend reconsidering this matter.

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

The peers are convinced that the relevant engineering related learning outcomes required by the "European Framework" especially in the fields of engineering analysis, engineering design and engineering practice can be achieved by students of the Bachelor's and the Master's programme Electrical Engineering and Information Technology and the Master's Programme Information and Communication Technology. Hence, they recommend awarding the label to these programmes.

Assessment for the award of the Euro-Inf® Label:

As to the Master's programme Computing, the peers deem it doubtless that the intended learning outcomes do not only comply with the subject specific criteria of the Technical Committee 04 – Informatics/Computer Science but, in principal, will be achieved by students as well. By comparison, the peers consider the achievement of the learning outcomes for the Bachelor's programme Computing being affected by the fact that some Informatics related fundamentals are provided or decively deepened not until the master level, as has been argued already. Therefore they recommend awarding the Euro-Inf® Label to the Master's programme Computing but at the same time postponing the awarding of the label to the Bachelor's programme Computing until the shortage in informatics fundamentals field has been reasonably removed.

B-3 Degree programme: structures, methods and implementation

B-3.1 Structure and modularity

The modules („courses“) have the following size:

- Bachelor’s programmes: compulsory courses generally 4 to 8 ECTS, some laboratory courses as well as some non technical courses are (in very few cases significantly) smaller in size (3 to 1 ECTS), so do the courses in the optional skills catalogue;
- Master’s programmes: modules in categories Theoretical Courses, Required Courses, Specialization Courses generally count 4 to 5 ECTS; apart from that, modules in the category Humanistic or Social Course are rated with 2 ECTS and so do many courses in the optional skills category; the project to be passed in the third semester is rated with 8 ECTS.
- Concerning *opportunities for study abroad* the HEI declares that it strongly supports the involvement of students in international student exchange programmes. Following the SAR, the faculty’s Office for International Cooperation, together with the International Relations Office of the University of Zagreb, organizes a wide range of programs related to international cooperation programs in accordance with the University of Zagreb's “Declaration for promotion of involvement in international exchange programs”. These programs primarily relate to student mobility programs. Reportedly, student mobility is implemented according to Erasmus bilateral agreements with European universities. The SAR states that in academic year 2011/2012 the Faculty signed agreements with 26 universities and agreed on 125 positions for student study visits, with the duration of one semester. Based on the University contest, 49 the FERstudents got the Erasmus program scholarships. It is also reported that the faculty for Electrical Engineering and Computing (FER) has a Double Degree programme in cooperation with the Polytechnic of Milan (Politecnico di Milano), Italy.
- For the purpose of *transferring course credits*, the FERhas appointed five professors to act as ETCS coordinators (two institutional, and three departmental). The ECTS coordinators are supposed to assist domestic students in applying to international programs, and to help international exchange students studying at FER. They should provide special assistance for the Learning Agreement. In order to facilitate selection of appropriate courses for international students, the FERspecifies three levels of English language support for all the undergraduate and graduate courses at the FER (level 1 to level 3; level 0 means no support for English). The level of English support for each course is listed on the course web page.
- Otherwise, the HEI concedes that it has just started pushing forward international mobility at graduate and postgraduate levels in the next five-year period.

Analysis of Peers:

In accordance with the ASIIN requirements, the Faculty has tailored courses as coherent and consistent packages of teaching and learning, and has coordinated and adapted courses in a manner that the achievement of objectives within the foreseen timespan will be supported.

Some of the technical courses (apart from the Skills courses and other non technical electives) are relatively small in scope and, accordingly, rated with a low number of credits (3 to only 1 ECTS credits). But this apparently applies to a low rate of courses, and therefore can hardly be viewed as a characteristic feature of the modularisation concept.

The FER has put in place opportunities for studies abroad, and is supporting these opportunities *inter alia* with its partizipation in European student exchange programmes (see also below, chapter B-5.3).

Assessement of Peers; ASIIN-Criterion 3.1:

The peers consider the requirements of the said criterion as sufficiently met already.

B-3.2 Workload and credit points

According to the self-assessment report, 1 ECTS credit equates to 25 – 30 hours of student workload. Each semester is composed of 30 ECTS on average (electives and Skills courses not counted). The academic year consist of 44 working weeks, out of which 30 weeks are direct teaching and 14 weeks are free of direct teaching, aimed for examinations and individual students' activity.

With regard to student workload the following rules need to be observed:

Art. 31 Statute of University of Zagreb Faculty of Electrical Engineering and Computing (Statute)

"(1) In an academic year, the student according to the curriculum enrols in courses with workload of 50 to 70 ECTS credits, or respectively 25 to 35 credits per semester. (1) In an academic year, the student according to the curriculum enrols in courses with workload of 50 to 70 ECTS credits, or respectively 25 to 35 credits per semester. [...]

(6) A student advances successfully through study if he or she in each academic year has earned at least 60 ECTS credits in accordance to the curriculum."

Art. 30 Statute

"(3) Exceptionally successful student may be allowed to complete the study in time shorter than prescribed. In one semester, such student may enrol in courses summing up to more than 35 ECTS credits."

Article 13 Regulations of the University Undergraduate and Graduate Studies at the University of Zagreb Faculty of Electrical Engineering and Computing (Regulations)

"(3) The dean may allow to an exceptionally successful student to enrol in courses exceeding 35 ECTS credits in total with the aim of completing the study sooner or to broaden the education. The upper limit is 60 ECTS credits per semester."

"(1) A student who complies to the conditions from Article 12, Section 6 and who has achieved the weighted average grade in all the passed examinations equal or greater than 4.50 is regarded as exceptionally successful."

Art. 28 Regulations

"(3) In a single semester, a student can enrol in courses [...] with total workload of at maximum 35 ECTS credits. To a regular student and to a student participating in international exchange it can be allowed to enrol in more than 35 ECTS credits with the intention to complete the study sooner or to acquire broader knowledge. [...]

(4) In a single semester, a student can enrol in courses [...] with the total workload of at least 25 ECTS credits. [...]"

"Regular student is the one who has not repeated the enrolment in any course and who has passed examinations in all the courses prescribed to the given moment by the curriculum." (Art. 12, Sec. 6)

Analysis of Peers:

Principally, student workload and allocation of credit points seem reasonable. The University and the FER regulations allowing for individual deviations within the range of 25 to 35 ECTS credits per semester are assumed to circumscribe the exceptions, 30 ECTS credit per semester being the standard workload. The regulations and the study course schedule for each programme confirm the assumption that the average workload of students per semester amounts to 30 ECTS.

The workload of students is assessed in the course evaluation process. It is not clearly identifiable from the information presented in the SAR whether systematic re-evaluation of credit point allocation has been conducted, and if so, led to concrete reallocation of credit points.

Assessement of Peers; ASIIN-Criterion 3.2:

The peers consider the requirements of the criterion fulfilled generally. They judge the already fixed range of student workload (25 to 35 ECTS credits per semester) as a flexible response to individual learning habits and different pace of learning. Still, they recommend – as it is already foreseen in the quality assurance concept of the HEI – to regularly evaluate the allocation of credit points in the course of quality assurance processes and to alter the assignment of credit points if necessary.

B-3.3 Educational methods

According to Article 10 *Regulations* the following educational methods are in use:

- Direct teaching can proceed in the following forms: lectures, turorials, auditory and laboratory exercises, experiments during lectures, demonstrations, field education, consultations etc.
- The student's individual work can proceed in following educational forms: as seminars, constructional exercises, acquiring of skills, programming exercises, e-Learning, other forms of group or individual learning etc.
  - In the courses Seminar at the undergraduate study and Graduate seminar at the graduate study, students are supposed to individually prepare and present actual topics from profession or science.
- Guided education comprises the joint work with the mentor on the Bachelor and the Graduation thesis and on the courses Project, Software project, Graduate Project etc.
  - In undergraduate courses Project and Software project and in the Graduate project, students in groups of six or more should enhance team compentences and project management competencies.

- Additional student's educational activities can be the professional practice, professional excursions etc.

Options for elective modules are available:

- Bachelor's programmes: selection of a specialization track ("module"); Courses for advanced students as well as Skills Courses to choose from respective course catalogues (on top of an average workload of mandatory courses of 30 ECTS credits)
- Master's programmes: selection of a specialization track ("profile"), selection of Specialization Courses, Mathematics and Science Courses, Humanistic or Social Courses (elective courses), and Skills Courses according to category related course catalogues.

Analysis of Peers:

The teaching methods used for implementing the didactical concept have been characterised by the teaching staff and students as appropriate to support the attainment of the learning objectives.

In general, a fair ratio of contact hours to self study seems to be implemented in the study programmes ensuring the achievement of the defined objectives. Seminars, projects and final thesis each contribute to famialiarising students with the needs and methods of independent scientific work.

Assessement of Peers; ASIIN-Criterion 3.3:

In view of the peers, the educational concept fully complies with the requirements of the respective criterion.

B-3.4 Support and advice

Offers for support and counselling of students are provided as described below:

- Student Counselling Service to students in the first and the second year of study in the Bachelor's programme; counsellors in the Student Counselling Service are professors representing all major courses in the first two years of study; appointed by the Faculty Council;
- Mentoring, provided by faculty members in the Bachelor, as well as in the Master's programmes. According to the SAR, in the Bachelor's programme each student is appointed a mentor (academic supervisor) at the beginning of the third year of study. According to that, the mentor takes the responsibility for the student's academic progress, selection of elective courses, and supervision of the undergraduate project (or software project, depending on the course of study) and the Bachelor thesis. In the Masters program, the mentor is assigned to the student upon enrolment. The mentor takes the responsibility for the student's academic progress, advising on elective courses, and supervision of the graduate seminar, the graduate project and the Master thesis.
- Regarding help in learning, all professors and assistants are available for individual and group consultations (consultation hours are published on the web).
- Reportedly, Student Association also provides self-organized student group learning and problem solving sessions at the Faculty over the weekend, where senior students assist junior students.
- A psychological counselling service for students is organized in cooperation with the Psychology Department of the Faculty of Philosophy.

- Office for Students with Disabilities as a reference centre in which students with disabilities and students with special needs may receive relevant information about their rights. According to the SAR, the Office assists students in solving specific problems that may occur during the course of study, and thus serves as a mechanism for ensuring equal opportunities. Two persons are appointed to act as representatives to the Office, one professor, as a Coordinator for students with disabilities and students with special needs, and one student. These two persons serve as contact points and provide the link between the students with disabilities and students with special needs, teachers and administrative staff at the Faculty, as well as the Office for Students with Disabilities at the University of Zagreb.
- JobFair project, established by the Student alliance and student club KSET, with the goal of presenting various employment opportunities to students after graduating at FER. JobFair aims at presenting several types of employment, such as working for a high-tech company, starting one's own business, and continuing one's education towards PhD and building a career as a researcher. At JobFair, students attend presentations of companies and research institutions, listen to personal experiences of former students who became entrepreneurs, and talk to company representatives in their booths.
- Student Ombudsman (elected by the Student union of the FER for one years time) for protecting students rights, in case violations should occur.

Analysis of Peers:

Students confirm that there are sufficient resources to guarantee support and counselling for students of different groups. They particularly emphasize the good student-teacher relations and the open-door policy which allows ad hoc and informal solutions to problems the students encounter.

Assessement of Peers; ASIIN-criterion 3.4:

The peers find the said criterion to be fully met by the counselling concept of FER. Especially, they appreciate the Mentoring concept, particularly in regard to its relevance for the individual study course and, most important at present, for the election of specialization tracks.

B-4 Examinations: system, concept and organisation

According to the self-assessment report and the information gathered during the discussions, the *exam methods* described subsequently are foreseen (see in particular *Regulations*, Art. 29):

- Concept of continued evaluation: modules (“courses” in the HEIs wording) are completed by passing mid-term exams and final exams; along with that continuous knowledge assessment encompasses at least one of the following components: homework, short knowledge checks, laboratory exercises, students’ active participation in the educational process etc.; in sum, results of the various assessments are aggregated to the student’s final grade by accumulating points;
- A student, who has not passed the course within the continuous knowledge assessment, can apply for examination in this course twice in the same academic year, under conditions that he or she has fulfilled the prerequisites prescribed in the curriculum.
- The student who has passed a course within the continuous knowledge assessment or in exam, but is not satisfied with the results achieved, can submit a plea to the principal course lecturer to allow admission to a following examination.
- Final examinations in continuous knowledge assessment and re-examinations are performed in written or in oral form, or in both written and oral form.

- Bachelor’s thesis is credited with 12 ECTS credits, Master’s thesis with 30 ECTS credits, Bachelors’s and Master’s thesis being completed with a colloquium (“defense of the Bachelor’s thesis resp. Master’s thesis”).
- On principle, graduation works (Bachelor’s and Master’s thesis) may be conducted externally.
- Assessment and grading specifications are enumerated and published in the course descriptions, available on the Faculty’s website.
- A detailed description of examination procedure and process, and the grading scheme for each course are published on the course web pages before the teaching starts.

Analysis of Peers:

Principally, examination types are aimed at covering the learning objectives which have been fixed for the respective courses. The diversity of assessment forms, including two exams (midterm and final exam) and a variety of other assessment types, appears typical of an assessment approach that monitors student achievements intensively. The additional midterm exams, which ar not standard at many HEIs, impose an additional workload on the teachers. On the other hand, students get a helpful feedback which eases their preparation for the final exam and tells them about their actual state of knowledge. All in all, teaching staff and students consider the multitude and variety of exams well suited to cover the learning achievements of students continually and comprehensively.

At first glance, the rules for examinations and advancement appear to be rather complicated. However, students and lecturers seemed to have a very good grasp of the regulations. This appraisal encompasses the procedural conditions for the repetition of exams as well. Taken together, the regulations apparently allow for an adequate exam preparation. They also seem to be transparent to students as far as grading criteria are concerned. Furthermore, students considered the organisation of examinations as appropriate and responsive to their needs.

In general, the discussions with students and lecturers confirmed the impression that the organization of exams is supportive regarding the achievement of the study objectives and in terms of completing studies within the standard period of study. Nevertheless, the examination rules as yet do not require that at least one of the examiners of the final thesis belongs to the body of full-time lecturers who deliver the programme. Furthermore, there are no rules governing the supervision of final thesis carried out externally, and ensuring its meaningful incorporation into the curriculum.

Assessement of Peers; ASIIN-criterion 4:

The peers find the requirements of the aforementioned criterion being met in large part, but that its purpose has not been fully served in terms of legal conditions of study (examiners of final thesis, external preparation of final thesis). Regarding that, they deem it essential to put provisions in place which guarantee that at least one of the examiners of the final thesis belongs to the body of full-time lecturers who deliver the programme. Furthermore, in their view the HEI must ensure in an appropriate manner that supervision of the final thesis carried out externally is addressed in strict rules, thereby assuring its meaningful incorporation into the curriculum.

B-5 Resources

B-5.1 Staff involved

According to the HEI, the teaching staff is composed of 65 full-time and 7 part-time Full Professors, 39 full-time and 6 part-time Associate Professors, 51 full-time and 15 part-time Assistent professors, 2 part-time teaching grades, 22 full-time and 15 part-time Teaching Assistents, 3 full-time and 14 part-time Assistents, 3 full-time Professional assistents, (127 Junior researchers) and 30 Technical staff.

More specifically the SAR states, that the structure of full time employed associates is internally judged as inadequate. Beside 22 permanently employed assistants, 127 junior researchers also participate in teaching. Reportedly, these are primarily hired by scientific criteria, but not according to teaching requirements thus resulting in a highly insufficient number of assistants at basic courses, both in initial study years, and in final study years (since the scope of the course is not an object of research within scientific research projects, junior researchers are connected with). The FER dees it appropriate and useful to hire new fulltime employed teaching staff for courses having a large number of enrolled students, whereas for teaching of specialised courses, external experts would be hired for the purpose of maintaining a high level of teaching.

In conjunction with this, the FER identifies as one of its significant staff problems the future of around 40 young researchers and assistants with a doctorate, of which the most have fulfilled requirements for election to scientific-lecturing positions, while at the same time no new assistant professors positions are open.

The FER’s self assessment reports register the following most important research & development activities (up to January 2012) relevant to the degree programmes and attributed to individual teaching staff of FER:

- CURE – Developing the Croatian underwater robotics research potential
- Aeolus – Distributed Control of Large-Scale Offshore Wind Farms
- ROBUSPIC – ROBUst mixed signal design methodologies for Smart Power Ics
- EECS – European Education Connectivity Solution
- LAFMOT – Luneberg Antenna For Multimedia On Train
- Multi criteria wind turbine control
- Exploration robot for fire fighting units
- MASTIF – Mapping and Assessing the State of Traffic Infrastructure
- Image Analysis Methods for Functional X-Ray Angio Imaging and Real-Time Guide Wire Tracking

Generally, the FER states that its research activities are primarily financed from domestic public sources, in collaboration with industry and from international sources, allowing active research work of doctoral students at the Faculty. Also reportedly, the activities of these projects involve students of graduate studies at the faculty that are designed and implemented as a research studies. Activity of students on projects can be measured by the number of published papers that have been co-authored by them and by the number of awards for research students at

University of Zagreb (Rector's Award) and the awards awarded by the Faculty in collaboration with partners from the industry.

According to the SAR, most of the research at the Faculty is applied research, while a portion is directly financed by Croatian companies according to a model in which the FER over the project period employs doctoral students in full time employment. After acquiring a doctoral degree they are employed in that company.

In that respect, the FER reports working in cooperation with local companies and government on the bases for the development of new products and services. Examples are new telecommunications services in collaboration with Ericsson Nikola Tesla company and the Croatian Agency for Post and Electronic Communications (HAKOM) or improving the design of power transformers, as one of the most important export products, in cooperation with Končar - Transformers.

Analysis of Peers:

In general, competence, composition and range of staff resourses appear to be well suited to conduct the study programmes under consideration. The Faculty's and teaching staff's fields of expertise and research activities are supportive and correspond to the structure and content of these programmes. This must be stated against a background of tight budgeting of human resources policy, and an industrial environment that, after all, is small in the disciplinary fields of the FER at least. Nevertheless, the FER and its teaching staff prove keen to consolidate its human resources and to broaden its scientific basis by intensifying its cooperation with companies and other research oriented institutions.

Assessement of Peers; ASIIN-criterion 5.1:

The peers acknowledge the achievements of the FER in teaching and research under economic and financial conditions which in some sense have been rather adverse than supportive in the recent past. In consequence, they consider the requirements of the criterion as satisfactorily addressed.

B-5.2 Staff development

The SAR reports on the following measures to subject-related and didactical further training for staff:

- Internal evaluation of every teacher at least once in three years time; issuing the report on the internal evaluation to the responsible the FER committee (*inter alia* evaluation of teaching: planning, managing the learning environment, knowledge transfer, employing the teaching strategies).
- Currently no *systematic* education aimed at improving the methodological and didactic competencies of its teaching staff; otherwise the FER stipulated in its Quality Assurance Statute "continuous education for purpose of improving the teaching and learning process" as a central quality objective.
- As a result, the FER's Committee for Quality Management recommended organizing a Workshop on teaching for all new Assistant Professors. One such workshop was

organized by the FER and Psychology Department of the Faculty of Philosophy, in academic year 1999/2000, at Sljeme in Zagreb (on modern methods of teaching).

- According to the Self Assessment Report, the FER suggests help of the University of Zagreb in further organizing this type of Workshop/Seminar on Teaching Methodology crucial, due to the limited funds available on the Faculty's side.

Analysis of Peers:

Despite certain instruments to develop and train teaching staff's didactical and professional skills being available already, it becomes clear from the report and the audit talks as well that a conclusive and systematic strategy concerning human resource development has not been implemented yet. On the other hand, initial steps have been taken so far and are committedly received by the teaching staff. Further measures are planned or, at least, initiated, and have been intensively discussed during the audit talks.

To further strengthen the didactical and professional competencies of teaching staff seems most important with regard to the Master's programmes and, generally, to ensure that the programmes will remain consonant with market developments and future developments in the fields of electrical engineering and computing as well.

Assessement of Peers; ASIIN-criterion 5.2:

The peers consider the requirements of the said criterion as already met by the FER's human resources policy. They strongly support further initiatives regarding the development of subject-relevant knowledge and teaching skills. In sum, they deem a recommendation to this end sufficient (with respect to exchange of teaching staff see also the following chapter 5.3).

B-5.3 Institutional environment, financial and physical resources

Faculty of Electrical Engineering and Computing is an organisational unit of the University of Zagreb which holds the founding rights in relation to the Faculty. It has adopted a department structure and is composed of altogether 12 departments: Department of Applied Physics; Department of Applied Mathematics; Department of Applied Computing; Department of Fundamentals of Electrical Engineering and Measurements; Department of Electric Machines, Drives and Automation; Department of Power Systems; Department of Telecommunications; Department of Electronic Systems and Information Processing; Department of Control and Computer Engineering; Department of Electroacoustics; Department of Electronics, Microelectronics, Computer and Intelligent Systems; Department of Wireless Communications.

FER, founded in 1956 as Faculty of Electrical Engineering, changed its name in 1995 to Faculty of Electrical Engineering and Computing, thereby recognizing the importance of computing sciences for most applications in the electrical engineering areas of knowledge and expertise.

The financial and infrastructural basis of the programmes has been described in detail in the SAR, as well as in the Self Assessment Report provided for National Accreditation, and, additionally, during the audit discussions at FER.

According to the SAR (including the SAR for National Accredition), the faculty has adopted the following cooperation strategy resp. concluded cooperation agreements with the following companies, businesses and institutions of Higher Education:

- intensifying internal relations within the University of Zagreb by deepening cross-faculty cooperation;
- The FER and business sector – partnership in research and development and professional projects is aimed to be intensively developed and is said to be strongly encouraged by the Faculty; also it is stated that through the active participation of recognized business professionals in the Faculty Council it is expected to create a partnership strategy that will define the framework of cooperation.
- Cooperation with the City of Zagreb which, though already existing, should be intensified in the future;
- Participation in programs of student mobility (incoming and outgoing), the mobility of teaching staff (incoming and outgoing teachers and ad hoc visits for the purpose of concluding new agreements and arrangements for new forms of cooperation), this also being reflected in the maintenance of existing agreements and the inclusion in new international university networks; student and teacher mobility primarily carried out through the following (student and lecturer exchange) programmes: ERASMUS, Double Degree, ERASMUS MUNDUS, CEEPUS, Bilateral agreements; furthermore cooperation takes place through other programmes like TEMPUS, Erasmus-Intensive Programmes and so forth.
- Lifelong Learning Programmes/Erasmus bilateral collaboration agreements for student exchange have been signed with a large number of European universities; and there is also a list of bilateral academic collaboration agreements with European and international HEIs.
- On an individual basis, the SAR (for the National Accredition, 2012) enumerates manifold connections of Faculty members to international and professional associations like Audio Engineering Society (AES), European Alliance of Medical and Biological Engineering and Science (EAMBES), European Association for Signal Processing (EURASIP), European Microwave Association (EuMA), European Nuclear Society (ENS), European Power Electronics and Drives Association, Power Electronics and Motion Control Council (EPE PEMC-C), European Society for Engineering and Medicine (ESEM), to mention only a few;
- The SAR (for the National Accredition, 2012) also lists (starting from October 2011) an international collaboration through ACROSS project with 15 European research institutions (Albert-Ludwigs-Universität Freiburg, The Royal Institute of Technology Stockholm, Technische Universität Wien, Technical University of Crete, IRISA/INRIA Rennes, Linköping University, University of Manchester, Tampere University of Technology, Karlstad University, University of Seville, Politecnico di Milano, National Technical University of Athens, Polytechnic of Bari, Swiss Federal Institute of Technology Zürich, Technische Universität München, Eindhoven University of Technology), with the goal of strengthening the Faculty's research potential in the area of cooperative robotic systems, renewable energy systems and network embedded systems.

Analysis of Peers:

In addition to the indications on human resources, the SAR delivers information on the infrastructure and financial budgeting in more detail. Moreover, during the on-site visit, the peers visited a variety of labs and the library. Overall, the information gathered contributes to the impression that resources generally facilitate the achievement of the study objectives.

Concerning the teachers' exchange programmes the FER is participating in, the peers have been told during the audit talks that the engagement of teachers is reluctant at best. This "inbreading" of competence is widely seen as a weakness because it, potentially, cuts off staff from participating in disciplinary/research developments. In this context, it has also been reported that consulting international experts within the course of staff recruitment processes, though always an option, has not been the rule at all. These habits might constrain the teaching staff's capability of rebuilding its professional knowledge and improving its teaching skills.

Assessement of Peers; ASIIN-criterion 5.3:

In general, the peers come to the conclusion that the requirements of the aforementioned criterion already are sufficienctly met. Nevertheless, from their point of view teacher's participation in international exchange programmes as well as consultation of international experts in staff recruitment processes should be encouraged through adequate means.

B-6 Quality Management: further development of degree programmes

B-6.1 Quality assurance and further development

Reportedly, the Faculty Council enacted the Statute of the Faculty of Electrical Engineering and Computing on June 29th, 2005. Article 26 of the Statute defines the Committee for Quality Management as a permanent working group of the Faculty Council. On March 16, 2011 then, the *Regulations of the Quality Assurance System at the University of Zagreb Faculty of Electrical Engineering and Computing* was enacted, which constitute the framework of quality assurance and define the activity scope of the Committee for Quality Management as an advisory and professional group of the Faculty Council and the Dean. According to this, the organizational structure for developing and implementing the quality assurance strategy shows up as follows:

- The Faculty Council is supposed to take care and to make decisions in order to assure quality of teaching process at FER.
- The Committee for Quality Management figures as permanent working body of the Faculty Council that is responsible for quality issues.
- The University Office for Quality Management takes responsibility for supervision of quality issues all over the University of Zagreb.

The SAR explains that the Committee for Quality Management organizes, coordinates and implements the evaluation procedures and develops the internal mechanisms for ensuring and improving the Faculty quality, especially regarding following elements:

- self-evaluation of the quality assurance system,
- development of quality indicators specific to the Faculty (e.g. number of applications with respect to the admission quota, number and quality of projects and scientific and research activities, interest of foreign students, etc.),
- activities of the teachers, students and service offices of the Faculty in monitoring of the study quality,

- analysis of the study process and causes of the below-average, inefficient and long study process,
- establishing competencies and development planning of the academic staff (lifelong education),
- establishing competencies and development planning of the administrative and technical staff,
- development and monitoring of teaching improvements indicators (e.g. accomplishment of the learning results, e-learning, success rate, literature availability, student employability, etc.),
- evaluation of the quality of the general and specific competencies realized through the study programme,
- definition, establishment and documenting of the standard operating procedures in the Faculty administration.

The SAR (National Accreditation; 2012) documents an overview of the FER internal quality assurance measures:

Table 1.1. Internal quality assurance

Type of activity	Responsible for the activity (name of the body or persons)	Frequency of the activity (number of annual meetings or activities)	Number of reports made in the course of specific activity in the last 3 years	Practical results of activities (descriptive)
Thematic sessions on teaching quality	Faculty Council	1 / year	1 (in the earlier assembly, the Vice Dean for education reported about the quality during the regular reports at the Faculty Council sessions)	The Ordinance for Quality Assurance System, changes of the curriculum, student questionnaires, internal evaluation
Activity of the board (committee) for teaching quality monitoring	Committee for Quality Management	5-10 /year (electronic and hardcopy)	26 meeting records, electronic mail	All activities regarding the quality assurance system
Student questionnaire (implementation, processing, informing students, teachers' responses)	Committee for Quality Management	3 / semester. Starting from 2011/2012, 2/semester	20	Conducting questionnaires, reporting, student discussions
SWOT analysis at the level of the institution	Committee for Quality Management	1	1	Within the external independent SOK revision
Monitoring quality indicators at HEI*	Committee for Quality Management, Faculty Council	-	-	-
Other forms of evaluation	Committee for Quality Management	5–10	3 x internal evaluation, Course yearly reports Opinions during election and reelection into scientific-educational title	Internal evaluation according to ASIIN accreditation. Course annual reports, opinions regarding evaluation of the teaching quality

** Ordinance on the content of license and conditions for issuing license for carrying out activities of higher education, carrying out study programmes and re-accreditation of higher education institutions (Official Gazette, no. 24/10 and Ordinance on conditions for issuing licence for carrying out scientific activity, re-accreditation of scientific organisations and content of license (Official Gazette, no. 83/2010)*

Thereby, as is further explained, the Committee cooperates with the Committee for Quality Management of the University of Zagreb, Office for Quality Management of the University of Zagreb, but also with the Agency for Science and Higher Education, and with the internal and external stakeholders of the quality assurance system at the Faculty:

- creating the strategy for improving quality of the Faculty,

- developing and recommending legal acts for management and improvement of the quality,
- executing the evaluation programme and procedure for improvement of the quality of the Faculty,
- coordinating implementation of the projects for professional development of the staff (academic, administrative and technical) at the Faculty,
- cooperating in preparation of the evaluation procedures,
- working on the Manual for Quality Assurance System that has been adopted by the unanimous decision of the Faculty Council on April 18, 2012.

As the SAR points out, the quality assurance system has beend adapted and further developed according to ESG during the external independent revision of the quality assurance system carried out by Agency for Science and Higher Education in Croatia in 2011 and 2012.

Analysis of Peers:

Obviously, the HEI and the FER have put in place a number of quality assurance measures which, step by step, have been coordinated and interlocked or are intended to be adapted accordingly. Students and teaching staff consonantly confirmed that the diverse evaluation processes as central elements of the quality assurance concept function constructively in providing indications for further improving teaching and learning conditions, and the study programmes in general. Apparently, the means for quality assurance have been found useful as a reliable benchmark for substantially checking whether the intended objectives are achievable and reasonable, and for identifying any failure in achieving those objectives. The data gathered may be even more informative if the FER accomplishes to closer relate evaluation questionnaires to the specialization tracks of the study programmes.

Assessement of Peers; ASIIN-criterion 6.1:

The peers find that the requirements of the said criterion have been met sufficiently. Still, they recommend to further develop the quality assurance concept of the study programmes under consideration (for example by introducing specialization-related questionnaires) and to use the data gathered and evaluated for continual improvements.

B-6.2 Instruments, methods & data

Thus, methods of quality measurements used by the Committee for Quality Management are:

- Measuring of student feedback by questionnaires (reported re-designing of questionnaires because of too much of them and to much questions as well, resulting in a steady decreasing student response and low turnout);
- Internal inspections undertaken by colleagues outside the course,
- Course review and self assessment.

Other methods are within the responsibility of the Vice Dean for education and include statistical data on examinations, student achievement data (duration of study, dropout rate), thematic sessions of the Faculty Council, student-teacher ratio, etc.

Procedures in quality measurements are:

- Student feedback:
    - Course entry evaluation,
    - End-of-Term evaluation,
- University of Zagreb Teacher Evaluation Form,
- University of Zagreb Study Programme Evaluation Form (since 2007/2008),
- Internal evaluation:
    - checklist,
    - procedures and guidelines,
- Annual course review:
    - Template for annual course review.

Universtiy of Zagreb questionnaire evaluating performance of professors in thei academic process and taking place once every three years on only one course the lecturer teaches add up to the Faculty’s course evaluation.

The results of the questionnaires are always available to the Vice Dean for education, Heads of Department, Boards of study programmes and individual course professors, and they take actions according to them. The questionnaires were not split into specialization tracks of study programmes; rather the database contains data about courses and responses to individual questions.

Following the decision of the University of Zagreb Quality Management Office that the student evaluation is to be done once every three years and due to the fact that professors regularly go through peer evaluation (“internal inspections”, see above) as part of their professional advancement, Faculty's Committee for Quality Management – according to the SAR – decided that internal evaluation shall be done every year, considering but only a third of the staff to be evaluated, yet leaving open the possibility that every lecturer may be evaluated more often than that.

In response to the recommendations of ASIIN peers in their first assessment of the study programmes under consideration the FER claims that course review and self assessment have been performed since with key issues tackling statistics, efficiency of teaching and learning, resources, improvement and grading of students, conformance of course content to the interest and needs of students, student support, action plan for the following year. Only minor changes in the programmes turned out to be necessary according to the SAR (National Accreditation).

The FER also concedes that, so far, the Committee had no official means of tracking what happens to the students when they graduate; though unofficial information has been gathered during annual meetings (e.g. Faculty Day or Department Days), relevant data is not systematically gathered yet. With the inclusion of the representative of alumni and external stakeholders into the Committee, the FER expects to develop and implement procedures for tracking the employability of graduates.

The FER indicates having taken measures based on the described methodology and procedures of quality management

- at the course level
  - improvement of learning and teaching materials,
  - higher teaching quality,
  - ECTS credit balancing.
- at the study level
  - improved modularity,
  - improved choice of courses with more courses offered,
  - introduction of new courses and skills.
- improvement in the exam procedures,
- professional advancement of professors based on student evaluation,
- improved resource management (facilities, laboratories, course schedule, information systems),
- modification of number and complexity of:
  - student questionnaires,
  - internal evaluation forms,
  - annual course reports.

Statistical data documenting the study success are presented in the SAR (for the Re-Accreditation procedure and the SAR National Accreditation): structure of enrolled students and interest for study programmes.

Analysis of Peers:

The SAR reasonably describes tools for quality assurance that were already in use or that are planned to be implemented. Survey data and results can be helpful in identifying weaknesses of the programmes and deriving appropriate remedies (however, see the reservation concerning potential updates of questionnaires with respect to the specializations' features as argued in the forgoing section). Yet, information on graduates' employment success is scarce (the general graduation record within the regular period of study notwithstanding).

Assessement of Peers; ASIIN-criterion 6.2:

In principle, the peers consider the requirements of the said criterion as met. With view to the employment success of graduates, they recommend systematically pursuing respective surveys in order to extract relevant information as to whether study objectives and quality expectations of the HEI are fulfilled.

B-7 Documentation and transparency

B-7.1 Relevant regulations

The regulations below have been provided for assessment:

- Statute of 29th January, 2011 (put into force)

- Regulations of the University Undergraduate and Graduate Studies at eht University of Zagreb Faculty of Electrical Engineering and Computing of April 20th, 2011 (put into force)
- Regulations of the Quality Assurance System at the University of Zagreb Faculty of Electrical Engineering and Computing of March 16th, 2011 (put into force)
- Student Disciplinary Regulations of June 29th, 2011 (put into force)

Analysis of Peers:

The regulations for study-relevant issues are in place and made available. These regulations include all the information necessary about the admission, course and completion of the degree.

Assessement of Peers; ASIIN-criterion 7.1:

The peers conclude that the requirements of the criterion are met in general, critical points referred to in other chapters of this report, which may affect them, notwithstanding.

B-7.2 Diploma Supplement and qualification certificate

Samples of the Diploma Supplement in English language are annexed to the self-assessment report. They provide information about the study aims and (generic) learning objectives, nature, level, context, content and status of the studies, the success of the graduate as well as about the composition of the final grade.

In addition to the national grade, an ECTS grading table according to the ECTS Users' Guide is *not* foreseen.

Analysis of Peers:

The FER provides subject specific Diploma Supplements for each study programme. These contain information as to the study objectives, the structure, level, content and status of the studies, the success of graduates as well as about the composition of the final grade. Still missing is a concise summary of the relevant learning outcomes illustrating the qualification profile of graduates of the respective study programme. The learning outcomes listed in the objectives matrices are far too long to serve this purpose, as has been indicated above (chapter B-2.2).

Furthermore, statistical data in addition to the final mark according to the ECTS Users' Guide or any regulation concerning the comparability of the individual final grade in the European Higher Education Area (EHEA) are not foreseen. Such data may assist in interpreting the individual degree.

Assessement of Peers; ASIIN-criterion 7.2:

The peers deem the requirements of the above cited criterion as not fulfilled sufficienctly yet. For reasons of transparency of the achieved competencies of graduates to potential stakeholders (like companies or other HEIs, in particular international ones) they consider it necessary to insert a succinct summary of relevant learning outcomes for each programme – and specialization of study, if needed. Along with that, in addition to the final grade an ECTS grading table according to the ECTS Users' Guide has to be inserted from their point of view, thus ensuring the (international) comparability of the grade.

C Additional Information

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

Not necessary

D Comment of the HEI (February 28, 2013)

Statement of the Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia (abbreviated as FER in sequel) in response to the preliminary ASIIN Accreditation Report received on February 14, 2013 that includes analysis and assessment of the peers is included in this section D. The statement is prepared by copying the exact wording of the analysis and assessment of the peers from the section B into this section and by amending our comments and statements directly into this text. Therefore, the structure of the section D exactly follows the structure of the section B with identical headings and sub-headings. In order to make our statement clearly visible from the remaining text, all our comments are highlighted in yellow colour.

D-1 Formal specifications

Analysis of Peers:

In general, the name of the resp. study programme reflects the study aims objectives and learning outcomes the Faculty of Electrical Engineering and Computing (FER) has committed itself to. Also, the name, by and large, reflects the disciplinary content of the resp. study programme. Nevertheless, labelling of the different "modules" in terms of *specialisation tracks* of the study programmes under consideration raises the question of consistency when looking at identical designations of "modules" and "profiles" in Bachelor's and Master's programmes that are not designed to be consecutive in the narrow sense. The peers will return to that problem in the following chapter (B-2.2).

Comment of the HEI:

FER statement regarding the organization of "modules" of the undergraduate programs, and "profiles" of the master programs, is included in the response to comments raised in the analysis of the peers and in the assessment of the peers regarding the ASIIN-Criterion 2.2.

Standard period of study and allocated credit points, expected intakes per study year and tuition fees are within regular range. As to the degree awarded, the information provided in the SAR and the acronyms used in the diploma supplements at hand seem to be unnecessary lengthy and complicated. But as it turns out, especially the acronyms refer, in Croatian language, to the familiar “Bachelor of Science” or “Master of Science” specified through the name of the study programme.

Comment of the HEI:

Degrees awarded by completion of the program and their corresponding acronyms in Latin were defined by the University Senate Decree. These were accredited by the Agency for Science and Higher Education and Ministry of Science, Education and Sports of the Republic of Croatia. Finally, they are regulated and enforced by the national legislation. These degrees cannot be easily translated into English language. Moreover, they have to be declared in the original national form without any translation in the Diploma Supplement according to the rules defining the content of the Diploma Supplement. Regarding the international recognition of these degrees, the familiar degrees: “Bachelor of Science” and “Master of Science” are the closest match to degrees awarded to candidates that have finished our study programmes.

Assessment of Peers; ASIIN criterion 1:

The peers judge the requirements of the said criterion to be adequately met. (With respect to the conception of specialization tracks see below chapters B-2.2, 2-6.) Overall, they suggest using the term “module” in the technical sense of comprehensive learning and teaching entity it is usually employed in the context of the Bologna process, thus avoiding any misunderstanding.

Comment of the HEI:

The terminology issue recognized by the peers indeed exist. It was inherited from early stages of program development. Ten specializations that exist in the third year of the two undergraduate programmes are termed as modules in our context. In usual Bologna terminology, the term "module" is used to denote a specific group of courses that students can enrol as an integral part of the study program. In our context, this term is used to denote a specialization in the last year of the undergraduate programme.

D-2 Degree Programme: content concept & implementation

D-2.1 Objectives of the degree programmes

Analysis of Peers:

The FER has duly classified the final degree in academic and professional terms. The formulated study aims reasonably refer to the qualification sought in a discipline related manner and in accordance with the EQR. This classification has been made publicly accessible for stakeholderns on the Faculty’s website.

Assessement of Peers; ASIIN Criterion 2.1:

The peers find the requirements of the criterion to be sufficiently met with the information at hand.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 2.1.

D-2.2 Learning outcomes of the degree programmes

Analysis of Peers:

Generally, it is commendable that the FER meticulously aims at defining qualification profiles for completion of the resp. study programmes, and in particular for graduation in the different spezialisation tracks of the degree programmes to be considered here.

Otherwise, it is very much to the detriment of the documentation of these qualification profiles, at least with regard to the specialization tracks in the Bachelor’s and Master’s programmes (“modules” resp. “profiles”), that the so called objectives matrices hardly demonstrate to what extent and in which way the formulated learning outcomes at programme level are carried through in the curriculum (i.e. on the module level). In addition, as the programme coordinators admitted to during the audit talks, the specialization tracks in the Bachelor’s programmes differ in subject specific courses with roughly 30 ECTS credit points only, thus even more highlighting their underlying affinity. Regarding the Master’s programmes, the heterogeneity of the corresponding specialization tracks seem to be much more obvious given their broad array of optional courses to be individually selected out of different disciplinary specific course catalogues. Due to this fact, it seems all the more necessary that the HEI plausibly demonstrates how specialization tracks, deeply affiliated by conception, form part of Bachelor’s and Master’s programmes that aren’t supposed to represent just *formally* separated entities.

Comment of the HEI:

Specializations of the undergraduate study program Electrical Engineering and Information Technology and the undergraduate study program Computing is achieved through 10 modules (5 modules for each of the programs). For each module, specialization is achieved by obligatory courses in the 5th and the 6th semester (in total 3 courses = 12 ECTS) and 3 elective courses in the 6th semester (3 x 4 = 12 ECTS), selected from the list of suggested elective courses for a particular module. Additionally, students are specialized through the undergraduate Project (6 ECTS) or Software Design Project (8 ECTS) and through the BSc Thesis (12 ECTS), which are all module-specific. Thus, the total of 42 ECTS points for Electrical Engineering and Information Technology programme and 44 ECTS points for Computing programme are part of the specialization, while the remaining 138 ECTS points (136 respectively) are common for each of the study programmes. Due to such organization, the learning outcomes are also separated in two parts in SAR. The first part is related to common outcomes of the study programme regardless of the specialization that arise from the common part of the programme (General outcomes: Knowledge and understanding, Engineering analysis, Engineering design abilities, Investigations abilities, Engineering practice and Transferable skills). Only these general outcomes are included in Diploma Supplement, since they are common for a study programme. The second part of outcomes is module-specific part of outcomes. These outcomes are included in the SAR for each of the ten modules. They arise from the specialization part of the program (42 or 44 ECTS points) and have almost one-to-one mapping to outcomes of courses that form the module-specific part of the program. Individual course-level learning outcomes are included in the supplementary document "ECTS Information Package, Course Catalogue – Undergraduate Study".

For master level programmes, specializations are defined by eleven profiles. Specialization starts from the first semester of these programmes. A smaller number of master level courses are offered as common courses for several profiles, whilst most of the courses are offered only within one specific profile. Therefore, learning outcomes for each individual profile that are included in the SAR as well as in the Diploma Supplement result directly from the course-level outcomes of a set of obligatory courses given within a particular profile. Individual course-level learning outcomes for all master level courses are included in the supplementary document "ECTS Information Package, Course Catalogue – Graduate Study".

And there is just another distinctive feature adding to this: Some specialization tracks of the Bachelor's programmes are not continued in the correspondent Master's programme, as one would suggest: e.g. the specialization wireless communication in the Bachelor's programme Electrical Engineering and Information Technology is not continued in the consecutive Master's programme but in the Master's programme Information and Communication Technology (specialization in wireless communication technologies); the specialization information processes and multimedia technologies in the Bachelor's programme Computing isn't continued in the consecutive Master's programme but in the Master's programme Information and Communication Technology as well; the spezialication electronic and computer engineering in the Bachelor's programme Electrical Engineering and Information Technology is continued not only in the correspondent Master's programme (specialization of the same name) but also in the Master's programme Computing ("profile" computer engineering). To be sure, this observation does not question the coherence and consistence of programme conception and structure principally, it may be reasonable and (more or less) well founded. Obviously, it partly relates to the institutional and disciplinary history of the Faculty and, partly, might be attributed to a flexible response of the FER to market demands (companies' needs and student request being intermingled), as some indications of programme coordinators suggested.

Comment of the HEI:

The issue raised by the peers, related to continuation of Bachelor level "modules" into correspondent Master level "profiles" might seem confusing. However, it arises from our goal to achieve a high degree of mobility between these two levels. The organizational concept is described textually and graphically in the section "2.1. Diagram of study programmes" of the supplementary document entitled "FER Self-evaluation". Students have a great flexibility in finishing one of the two undergraduate programmes and enrolling into any of the three graduate programmes. For many combinations, enrolment is possible without any bridge courses. Such flexibility was made possible by having significant overlap in fundamental knowledge and common learning outcomes that are achieved on both undergraduate programmes. Modules (specializations) of the undergraduate programmes are designed in order to satisfy the requirements of the labour market. However, having in mind that the majority of young people who enrol in this Faculty are of high quality and with large potential, the division into modules presents a good preparation for the students who shall continue their education on the graduate level (this makes today over 98.5 % of students) on corresponding profiles. Meanwhile, they are supplied with knowledge broad enough to enable them to choose on the graduate study also some other profile, but possibly having to enrol in some bridge courses.

Be that as it may, these differences of the programmes and specialization tracks need to be identifiable to all stakeholders (students and applicants of the resp. programmes in the first place), and their implementation into the curricular conception of these programmes needs to be comprehensible. Unfortunatedly, the matrices, which should have illustrated this, do not refer to the module level ("module" in terms of the familiar Bologna-related meaning of study package; "courses" in the terminology of the SAR). As a result, one cannot derive from the matrizes the conclusion that the FER has done its homework properly but has to carefully check whether the course content of every single specialization track reflects the qualification profile sought. Nevertheless, this deficit in large part seems to pose a problem of illustration or demonstration and is not or at any rate not primarily a problem of curricular structure or content.

Comment of the HEI:

The concept of "module" in terms of the familiar Bologna-related meaning of study package is not utilized in the description of learning outcomes of our study programmes. Instead of grouping related complementary courses that are specific to certain group of learning outcomes into "modules" according to the usual Bologna terminology, we use **flat model** for description of learning outcomes. In such a flat model, learning outcomes of the study programs are directly related to the course-level learning outcomes without this intermediate hierarchical entity that is termed "module" in the common Bologna terminology.

Finally, it should be noticed that the definition of learning outcomes for the study programmes appear way too long to be used for example as succinct information on the academic and professional qualifications of graduates in the Diploma Supplement. A short and yet precise description of achieved qualifications as part of the Diploma Supplement helps stakeholders like other HEIs or business/industry companies in finding out whether applicants match the requirements for concrete job offers (see below chapter B-7.2).

Comment of the HEI:

Regarding the undergraduate study programmes, only the common learning outcomes are included in the Diploma Supplement, i.e. without the module-specific part that is related to the specialization in the third year of the study programmes. Learning outcomes at the level of study programmes that are currently included in the Diploma Supplements have not changed from the first ASIIN accreditation, i.e. they were prepared back in academic year 2005/2006. These were one of the first systematically defined study program outcomes for the whole University of Zagreb. As such they were included in two University publications related to the learning outcomes as good-practise examples ("Ishodi ucenja u visokom skolstvu", 2008 and "Ishodi ucenja na Sveucilistu u Zagrebu", 2009).

Assessement of Peers; ASIIN-Criterion 2.2:

The peers evaluated the requirements of the criterion as not sufficiently fulfilled yet. They found it indispensible that the name of the study programme, the name of specialization track ("module" or "profile"), and the corresponding learning outcomes (in terms of qualification profiles) as well as the study content have to be made consonant with each other. Their coherence must be plausibly demonstrated in the goal matrix for each programme.

Furthermore, study aims and intended learning outcomes must be made accessible to the relevant stakeholders, in particular students and lecturers, in such way that students are able to appeal to them (for example in the course of internal quality assurance processes).

Assessment for the award of the EUR-ACE® Label for the Bachelor's and the Master's programme Electrical Engineering and Information Technology and Information and Communication Technology:

The deficits in strictly illustrating how the defined learning outcomes are implemented in the curriculum notwithstanding, the peers deemed the intended learning outcomes of the said degree programmes fully complying with the engineering specific part of Subject-Specific Criteria of the Technical Committee 02 – Electrical Engineering and Information Technology.

Assessment for the award of the Euro-Inf Label® for the Bachelor's and the Master's programme Computing:

The deficits in strictly illustrating how the defined learning outcomes are implemented in the curriculum notwithstanding, the peers deemed the intended learning outcomes of the said degree programmes fully complying with the Subject-Specific Criteria of the Technical Committee 04 – Informatics/Computer Science.

Comment of the HEI:

Statement regarding the assessment of the peers ASIIN-Criterion 2.2 is included in the preceding section "Analysis of Peers" through several relevant comments.

D-2.3 Learning outcomes of the modules/module objectives

Analysis of Peers:

In general, the module descriptions are informative and precise. In particular, the learning outcomes are described sufficiently and transparently, thereby yielding a sound basis for the assessment of the students' and graduates' knowledge, skills and competencies. The stated objectives and learning outcomes provided a reference for the evaluation of the programmes' curricula and resources.

In addition, it could be stated that the descriptions (and other relevant study information) are available electronically to students, teachers and other interested parties.

Assessement of Peers; ASIIN-Criterion 2.3:

The peers conclude that the requirements of the criterion have been approached adequately. Nonetheless, they encourage programme coordinators and teaching staff alike to maintain and further work on the quality of the module (course) descriptions.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN Criterion 2.1. Additionally, since the course-level learning outcomes are part of the "ECTS Information Package, Course Catalogue" which is updated and voted for annually by the Faculty Council, teachers are encouraged to update the course-level learning outcomes regularly to ensure the consistency with the achieved and verified competences.

D-2.4 Job market perspectives and practical relevance

Analysis of Peers:

The job perspectives in the fields of the said degree programmes are good, which partly may be due to the apparently close links of the FER to companies in the region and abroad.

In accordance with that, the current integration of practical elements into the curriculum of the study programmes under consideration seems to be suitable to prepare students for handling tasks and problems in their future work positions. Otherwise, programme coordinators, teaching staff and students consonantly agree to the impression of a certain disregard of the Bachelor degree in companies and public sector institutions as well. May this be due to a lack of knowledge or to manifest doubts whether bachelor graduates dispose of professional competencies sufficiently, it certainly raises the awareness for all parts of study directly linked to professional practice. In this respect, apart from laboratory exercises, field education and projects, an industrial placement as an obligatory element of the curriculum bears vital importance for acquiring fundamental competencies needed in professional work environments. Yet, while such an Industrial Internsphip is integrated as on optional element in the Master's programmes, it is altogether left out of the curriculum of the Bachelor's pogrammes. Experience has shown that in the Electrical Engineering and Information Technology field at least, industrial internships contribute significantly to students' ability to individually and responsibly conduct profession- and subject-related tasks in a company.

Assessement of Peers; ASIIN criterion 2.4:

The peers conclude that the requirements of the above mentioned criterion are met sufficienctly. Though, with view to the Bachelor's programme Electrical Engineering and Information Technology they recommend implementing a mandatory Industrial Placement for all students in order to improve their ability to individually and responsibly conduct profession- and subject-related tasks in a company.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN Criterion 2.4. Regarding the suggested Industrial Placement, we agree that such practical part of the programme is very important and must be included. In recognition of that fact, we have started the program of Summer Internship in the academic year 2011/2012 that is offered to the Master level students of all three study programmes after completing their first year of study. When introducing this activity, the Faculty Council decided that at this stage it is more important to offer Industry Placement to Master level students, rather than Bachelor level students. Primary reason for such decision was that at this stage students have completed a total of four years of study and have gained sufficient theoretical background and practical skills that enables them to fully utilize the opportunity of Industrial Placement. Our industry partners also supported this decision, since they were able to assign compelling and challenging tasks to such motivated students that were supposed to finish their master level studies in only one-year time. Finally, this opportunity was welcomed by our students, many of whom established close ties with these companies for potential employment. According to the current statistics based on the last five years of enrolement, 98.5 % of students finishing Bachelor's programme continue to the Master level study programmes. Thus, practically all have the opportunity to expand their education through the Summer Internship program.

D-2.5 Admissions and entry requirements

Analysis of Peers:

The applicable admission requirements are transparent and accessible to all stakeholders involved, and they seem to be strictly applied. Not least the generally high graduation record within the standard period of study seems to confirm that the admission requirements positively correspond with the achievement of learning outcomes and, more generally, of the quality objectives pursued at the FER.

As the FER's list of instruments and offers for counselling and advice of students and applicants show (see below chapter B-3.3) and audit discussions confirm, the Faculty strives to identify from the outset students' or applicants' competencies and shortcomings with regard to the elected study programme. Obviously, these measures do not only aim at identifying students' capabilities for commencing a programme but also to provide appropriate support for improving the learning process.

Existing regulations concerning the recognition of activities completed externally appear to be in accordance with ASIIN requirements and chapter III of the Lisbon Convention.

Assessement of Peers; ASIIN-Criterion 2.5:

The peers judge the said criterion as being addressed adequately. With regard to the recognition of activities completed at other HEIs or at institutions/learning environments other than HEIs they assume that the FER proceeds in accordance with the formal and procedural setting as described in its SAR.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 2.5.

D-2.6 Curriculum/content

Analysis of Peers:

All in all, learning outcomes are reflected in the respective course content and it can be derived from that, in general, that they will be achieved by students. Principally, the same is true for the internal adjustment and coordination of the modules/courses.

Three topics have been intensively discussed at the FER: firstly, the structure of the study programmes in general, secondly, the multiple specialisations in each programme under consideration, and thirdly, the underlying concept of the Computing programmes, in particular the Bachelor's programme of Computing.

1) The diversity of programmes which are closely related and strongly intertwined is, of course, noticeable at FER. This holds true even more so for the numerous specialisations in the Bachelor's as well as in the Master's programmes. For the Bachelor's programmes at least, which are normally designed to lay the scienctific and engineering foundations and to make students aquainted with the different subject specific areas of expertise, it is not usual to focus students' interest on specialties of the discipline at this stage of their academic education. According to the programme coordinators, this strategy has been adopted primarily in order to meet requirements of the job market, more or less openly claimed by business or industry companies. Otherwise, the effects of this decision apparently remain to be contested within the Faculty and teaching staff of FER. It has been the aim to strengthen the employability of graduates by tailoring the Bachelor's programmes along the specific demands of industry and business. But the net effect of that conceptual strategy has been judged disputable, thus forcing programme coordinators and teaching staff to consider establishing only two pure undergraduate programms in Electrical Engineering and Information Technology resp. Computing in the medium term, thereby enabling even deeper disciplinary specialisations in the Master's programmes.

2) At present, programme coordinators conceded that the specialisations in the Bachelor's programmes not always find their continuation in the formally consecutive Master's programme one would expect (i.e. that of the same name; see above chapter B-2.2) but in another Master's programme. This has been largely explained with specialization preferences of Bachelor graduates of the Computing programme, and in that sense as a purely technical device. Any misunderstanding on the students' side is said to be effectively avoided through the first study year which is essentially the same for students of both Bachelor's programmes, and through FERs constant advising and counselling during the study progress, in particular with regard to the election of specializations in the Bachelor's and Master's programmes.

3) The identical curriculum for the first study year in both Bachelor's programmes raises the question whether the wide ranging, engineering related basic training suits the needs of Bachelor students in different programmes equally well. Programme coordinators pointed out that a broad and fundamental engineering education in the early stages of the Bachelor's programmes has been exactly aimed at by curriculum planners. Essentially, this would suit a more hardware oriented tradition in computing education at the FER (*computer engineering* in combination with computer science). That way, teaching physics courses instead of deepening Informatics/Computer Science related fundamentals and core subjects (like Discrete Mathematics, formal methods, programming, modelling, software systems, software enginee-ring) is accepted though intensively discussed among the teaching staff, particularly as far as lecturers in the Computing programmes are concerned. Students vividly shared the view that the common engineering education in the two Bachelor's programmes go at the expense of a more specific designed curriculum in the Informatics area. Taking into account what has been previously noted about changes in the programme structure at the undergraduate level that are already discussed or even under way, these alterations (implementing to distinct Bachelor's programmes in the Electrical Engineering respectively in the Computing field) might prove just as well as possible solutions of the problem addressed here. But until then, shortcomings in the

field of mathematics and natural sciences related to computing in a narrower sense remain to be stated in the Bachelor's programme Computing.

As to the elective and, particularly, "Skills" courses the FERrepresentatives make it clear that these courses are awarded ECTS credits additionally (i.e. outside the regular 180 ECTS resp. 120 ECTS framework for Bachelor's and Master's programmes), and by the same token are listed in the Certificate and Diploma Supplement, but do not form part of the final grading.

Assessement of Peers; ASIIN-Criterion 2.6:

The peers deem the requirements of this criterion being fulfilled to a large extent, but not sufficiently yet for the Bachelor's programme Computing. They appreciate internal discussions on and approaches to structural modifications in the Bachelor's programme Computing in particular, as outlined by programme coordinators. In the short run though, they deem it necessary to adjust the curriculum of the Bachlor's Programme Computing in such a way that students achieve more competencies in the fundamentals of Informatics and related basics (like Discrete Mathematics, formal methods, modelling etc.) at the intended level. This might be accomplished for example by reducing contents of lesser importance for the programme (as for instance Physics or Higher Analysis).

Furthermore, the peers question the allocation of credits to the non-academic Skills courses like Chess, Bridge etc. However understandable those courses may be in view of motivational and social considerations, their awarding of credits seems disputable. The peers therefore recommend reconsidering this matter.

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

The peers are convinced that the relevant engineering related learning outcomes required by the "European Framework" especially in the fields of engineering analysis, engineering design and engineering practice can be achieved by students of the Bachelor's and the Master's programme Electrical Engineering and Information Technology and the Master's Programme Information and Communication Technology. Hence, they recommend awarding the label to these programmes.

Assessment for the award of the Euro-Inf® Label:

As to the Master's programme Computing, the peers deem it doubtless that the intended learning outcomes do not only comply with the subject specific criteria of the Technical Committee 04 – Informatics/Computer Science but, in principal, will be achieved by students as well. By comparison, the peers deem the achievement of the learning outcomes for the Bachelor's programme Computing being affected by the fact that some Informatics related fundamentals are provided or decively deepened not until the master level, as has been argued already. Therefore they recommend awarding the Euro-Inf® Label to the Master's programme Computing but at the same time postponing the awarding of the label to the Bachelor's programme Computing until the shortage in informatics fundamentals field has been reasonably removed.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 2.6. Comments raised by the peers are a natural consequence of the intended and designed structure of the two Bachelor's programmes. The undergraduate study commences with a one-year common study programme. After that, separate one-year study programmes follow for the study of Electrical Engineering and Information Technology and for the study of Computing. After that, each study branches into modules. The common initiation of study for all the students of Electrical Engineering and Information Technology and Computing has surely its reasons but it also bears possible deficiency. The two professions are interwoven and it allows the student to postpone his/her decision between these two fields for a year, to get better acquainted with both professions and to make accordingly a more competent decision. On the other hand, the programme of the first year of undergraduate study is a result of a compromise that combines common competences that were found necessary for both study programs. The issue of such structure has been actively discussed for a long time, and certainly it will be discussed much more in the future while designing a new study programme, taking into account the experience gained from the current programme. When considering the current Bachelor's programme Computing and its structure, it must be recognized that this undergraduate program must lay proper foundations for all of the following Master level study programs and corresponding profiles:

- Master's programme Computing, Profile Software Engineering and Information Systems
- Master's programme Computing, Profile Computer Engineering
- Master's programme Computing, Profile Computer Science
- Master's programme Information and Communication Technology, Profile Telecommunication and Informatics
- Master's programme Information and Communication Technology, Profile Information Processing

Out of total number of 1361 students enrolled into these five profiles in the last five academic years, 1338 students finished Bachelor's programme Computing while only 23 came from the Bachelor's programme Electrical Engineering and Information Technology. Therefore, the current structure of the Bachelor's programme Computing was tailored to fulfil the requirements of all of the above five profiles, by suitably combining competences in fundamental sciences (mathematics, physics), electrical engineering and information technology and computing. Possible deficiency of the Informatics related fundamentals in the Bachelor's programme Computing identified by the peers affects primarily two profiles of the Master's programme Computing, namely profiles: Software Engineering and Information Systems and Profile Computer Science. However, as was also noted by the peers, most of these insufficiencies are covered in the corresponding Master's programme. This certainly is too late for students that are not continuing their studies at Master level, but one must have in mind that currently only 1.5 % of students are in this category that stops at the Bachelor's level. As our peers were informed during the visit, FER is currently in the process of considering necessary changes of the programme structure at the undergraduate and graduate levels as well. As one of conclusions of the thematic Faculty Council meeting held on November 28, 2012 that covered exactly the topic of necessary modification of the study programme, it was decided that current structure with the common first year of the study should be reconsidered by possibly implementing two distinct Bachelor's programmes in the Electrical Engineering respectively in the Computing field. For the case of greater alternations of the study programme structures, as this would be the case, the required procedure of approval is rather lengthy since it involves relevant committees at the University level, as well as approval by the Agency for Science and Higher Education, with a typical duration of two years. It also involves a national reaccreditation. Right now, we have started this procedure at the Faculty level only. Therefore, the soonest that these changes might come into effect is in the academic year 2014/2015.

For the case of smaller programme modifications, the approval procedure is simpler and faster. Based on the analysis and assessment of the peers contained in this Preliminary Accreditation report, heads of the three Faculty departments that significantly contribute to the Computing part of our program have prepared a proposal for such a smaller curriculum modification to address the identified deficiencies. The document containing this proposal is included as an attachment to this report entitled "RevisionBSC_Comp_ASIIN FINAL.pdf" together with a table that demonstrates mapping of modules (courses) to the learning outcomes required by the Euro-Inf label. The attachment is labelled "Learning Outcomes Computing_BCs FINAL.xlsx". Due to a very short time period between the date we received this preliminary report and due date for submission of the statement, this proposal is only informal and has not been approved by the relevant committees nor by the Faculty Council.

Regarding the comment of the peers about the skills Chess and Bridge, we will reconsider allocation of ECTS for these skills.

D-3 Degree programme: structures, methods and implementation

D-3.1 Structure and modularity

Analysis of Peers:

In accordance with the ASIIN requirements, the Faculty has tailored courses as coherent and consistent packages of teaching and learning, and has coordinated and adapted courses in a manner that the achievement of objectives within the foreseen timespan will be supported.

Some of the technical courses (apart from the Skills courses and other non technical electives) are relatively small in scope and, accordingly, rated with a low number of credits (3 to only 1 ECTS credits). But this apparently applies to a low rate of courses, and therefore can hardly be viewed as a characteristic feature of the modularisation concept.

The FER has put in place opportunities for studies abroad, and is supporting these opportunities *inter alia* with its partizipation in European student exchange programmes (see also below, chapter B-5.3).

Assessement of Peers; ASIIN-Criterion 3.1:

The peers consider the requirements of the said criterion as sufficiently met already.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 3.1.

D-3.2 Workload and credit points

Analysis of Peers:

Principally, student workload and allocation of credit points seem reasonable. The University and the FER regulations allowing for individual deviations within the range of 25 to 35 ECTS credits per semester are assumed to circumscribe the exceptions, 30 ECTS credit per semester being the standard workload. The regulations and the study course schedule for each programme confirm the assumption that the average workload of students per semester amounts to 30 ECTS.

The workload of students is assessed in the course evaluation process. It is not clearly identifiable from the information presented in the SAR whether systematic re-evaluation of credit point allocation has been conducted, and if so, led to concrete reallocation of credit points.

Assessement of Peers; ASIIN-Criterion 3.2:

The peers consider the requirements of the criterion fulfilled generally. They judge the already fixed range of student workload (25 to 35 ECTS credits per semester) as a flexible response to individual learning habits and different pace of learning. Still, they recommend – as it is already foreseen in the quality assurance concept of the HEI – to regularly evaluate the allocation of credit points in the course of quality assurance processes and to alter the assignment of credit points if necessary.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 3.2. Periodic re-evaluation of credit point allocation is integrated into the quality assurance processes at FER. Modification can be proposed on yearly bases. Such modifications are approved by the Faculty Council as an integral part of the "ECTS Information Package, Course Catalogue – Undergraduate Study" and "ECTS Information Package, Course Catalogue – Graduate Study" for each academic year.

D-3.3 Educational methods

Analysis of Peers:

The teaching methods used for implementing the didactical concept have been characterised by the teaching staff and students as appropriate to support the attainment of the learning objectives.

In general, a fair ratio of contact hours to self study seems to be implemented in the study programmes ensuring the achievement of the defined objectives. Seminars, projects and final thesis each contribute to famialiarising students with the needs and methods of independent scientific work.

Assessement of Peers; ASIIN-Criterion 3.3:

In view of the peers, the educational concept fully complies with the requirements of the respective criterion.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 3.3.

D-3.4 Support and advice

Analysis of Peers:

Students confirm that there are sufficient resources to guarantee support and counselling for students of different groups. They particularly emphasize the good student-teacher relations and the open-door policy which allows ad hoc and informal solutions to problems the students encounter.

Assessement of Peers; ASIIN-criterion 3.4:

The peers find the said criterion to be fully met by the counselling concept of FER. Especially, they appreciate the Mentoring concept, particularly in regard to its relevance for the individual study course and, most important at present, for the election of specialization tracks.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 3.4.

D-4 Examinations: system, concept and organisation

Analysis of Peers:

Principally, examination types are aimed at covering the learning objectives which have been fixed for the respective courses. The diversity of assessment forms, including two exams (midterm and final exam) and a variety of other assessment types, appears typical of an assessment approach that monitors student achievements intensively. The additional midterm exams, which ar not standard at many HEIs, impose an additional workload on the teachers. On the other hand, students get a helpful feedback which eases their preparation for the final exam and tells them about their actual state of knowledge. All in all, teaching staff and students consider the multitude and variety of exams well suited to cover the learning achievements of students continually and comprehensively.

At first glance, the rules for examinations and advancement appear to be rather complicated. However, students and lecturers seemed to have a very good grasp of the regulations. This appraisal encompasses the procedural conditions for the repetition of exams as well. Taken together, the regulations apparently allow for an adequate exam preparation. They also seem to be transparent to students as far as grading criteria are concerned. Furthermore, students considered the organisation of examinations as appropriate and responsive to their needs.

In general, the discussions with students and lecturers confirmed the impression that the organization of exams is supportive regarding the achievement of the study objectives and in terms of completing studies within the standard period of study. Nevertheless, the examination rules as yet do not require that at least one of the examiners of the final thesis belongs to the body of full-time lecturers who deliver the programme. Furthermore, there are no rules governing the supervision of final thesis carried out externally, and ensuring its meaningful incorporation into the curriculum.

Assessement of Peers; ASIIN-criterion 4:

The peers find the requirements of the aforementioned criterion being met in large part, but that its purpose has not been fully served in terms of legal conditions of study (examiners of final thesis, external preparation of final thesis). Regarding that, they deem it essential to put provisions in place which guarantee that at least one of the examiners of the final thesis belongs to the body of full-time lecturers who deliver the programme. Furthermore, in their view the HEI must ensure in an appropriate manner that supervision of the final thesis carried out externally is addressed in strict rules, thereby assuring its meaningful incorporation into the curriculum.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 4. Regarding the comment related to examiner of the final thesis additional explanation and clarification is included in sequel. This issue is regulated by "Regulations of the University Undergraduate and Graduate Studies at the University of Zagreb Faculty of Electrical Engineering and Computing" (in attachment: "Regulations of FER BSc and MSc.doc"). According to the Article 31, Completion of undergraduate studies, (16) *The examination commission members can be teachers and associates. At least one member must be a teacher*. Similar, according to the Article 33, Completion of graduate studies, (18) *The examination commission members can be persons with scientific-educational or scientific titles. At least one of them must be an associate or a full profess*or. According to our national legislation, teacher ("nastavnik" in Croatian) is a person with scientific-educational title employed by HEI institution as a member of Faculty. This title includes a full-time assistant professor, full-time associate professor and full professor.

D-5 Resources

D-5.1 Staff involved

Analysis of Peers:

In general, competence, composition and range of staff resourses appear to be well suited to conduct the study programmes under consideration. The Faculty’s and teaching staff’s fields of expertise and research activities are supportive and correspond to the structure and content of these programmes. This must be stated against a background of tight budgeting of human resources policy, and an industrial environment that, after all, is small in the disciplinary fields of the FER at least. Nevertheless, the FER and its teaching staff prove keen to consolidate its human resources and to broaden its scientific basis by intensifying its cooperation with companies and other research oriented institutions.

Assessement of Peers; ASIIN-criterion 5.1:

The peers acknowledge the achievements of the FER in teaching and research under economic and financial conditions which in some sense have been rather adverse than supportive in the recent past. In consequence, they consider the requirements of the criterion as satisfactorily addressed.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 5.1.

D-5.2 Staff development

Analysis of Peers:

Despite certain instruments to develop and train teaching staff's didactical and professional skills being available already, it becomes clear from the report and the audit talks as well that a conclusive and systematic strategy concerning human resource development has not been implemented yet. On the other hand, initial steps have been taken so far and are committedly received by the teaching staff. Further measures are planned or, at least, initiated, and have been intensively discussed during the audit talks.

To further strengthen the didactical and professional competencies of teaching staff seems most important with regard to the Master's programmes and, generally, to ensure that the programmes will remain consonant with market developments and future developments in the fields of electrical engineering and computing as well.

Assessement of Peers; ASIIN-criterion 5.2:

The peers consider the requirements of the said criterion as already met by the FER's human resources policy. They strongly support further initiatives regarding the development of subject-relevant knowledge and teaching skills. In sum, they deem a recommendation to this end sufficient (with respect to exchange of teaching staff see also the following chapter 5.3).

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 5.2.

D-5.3 Institutional environment, financial and physical resources

Analysis of Peers:

In addition to the indications on human resources, the SAR delivers information on the infrastructure and financial budgeting in more detail. Moreover, during the on-site visit, the peers visited a variety of labs and the library. Overall, the information gathered contributes to the impression that resources generally facilitate the achievement of the study objectives.

Concerning the teachers' exchange programmes the FER is participating in, the peers have been told during the audit talks that the engagement of teachers is reluctant at best. This "inbreading" of competence is widely seen as a weakness because it, potentially, cuts off staff from participating in disciplinary/research developments. In this context, it has also been reported that consulting international experts within the course of staff recruitment processes, though always an option, has not been the rule at all. These habits might constrain the teaching staff's capability of rebuilding its professional knowledge and improving its teaching skills.

Assessement of Peers; ASIIN-criterion 5.3:

In general, the peers come to the conclusion that the requirements of the aforementioned criterion already are sufficienctly met. Nevertheless, from their point of view teacher's participation in international exchange programmes as well as consultation of international experts in staff recruitment processes should be encouraged through adequate means.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 5.3.

D-6 Quality Management: further development of degree programmes

D-6.1 Quality assurance and further development

Analysis of Peers:

Obviously, the HEI and the FER have put in place a number of quality assurance measures which, step by step, have been coordinated and interlocked or are intended to be adapted accordingly. Students and teaching staff consonantly confirmed that the diverse evaluation processes as central elements of the quality assurance concept function constructively in providing indications for further improving teaching and learning conditions, and the study programmes in general. Apparently, the means for quality assurance have been found useful as a reliable benchmark for substantially checking whether the intended objectives are achievable and reasonable, and for identifying any failure in achieving those objectives. The data gathered may be even more informative if the FER accomplishes to closer relate evaluation questionnaires to the specialization tracks of the study programmes.

Assessement of Peers; ASIIN-criterion 6.1:

The peers find that the requirements of the said criterion have been met sufficiently. Still, they recommend to further develop the quality assurance concept of the study programmes under consideration (for example by introducing specialization-related questionnaires) and to use the data gathered and evaluated for continual improvements.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 6.1.

D-6.2 Instruments, methods & data

Analysis of Peers:

The SAR reasonably describes tools for quality assurance that were already in use or that are planned to be implemented. Survey data and results can be helpful in identifying weaknesses of the programmes and deriving appropriate remedies (however, see the reservation concerning potential updates of questionnaires with respect to the specializations' features as argued in the forgoing section). Yet, information on graduates' employment success is scarce (the general graduation record within the regular period of study notwithstanding).

Assessement of Peers; ASIIN-criterion 6.2:

In principle, the peers consider the requirements of the said criterion as met. With view to the employment success of graduates, they recommend systematically pursuing respective surveys in order to extract relevant information as to whether study objectives and quality expectations of the HEI are fulfilled.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 6.2.

D-7 Documentation and transparency

D-7.1 Relevant regulations

Analysis of Peers:

The regulations for study-relevant issues are in place and made available. These regulations include all the information necessary about the admission, course and completion of the degree.

Assessement of Peers; ASIIN-criterion 7.1:

The peers conclude that the requirements of the criterion are met in general, critical points referred to in other chapters of this report, which may affect them, notwithstanding.

Comment of the HEI:

FER agrees with the analysis and assessment of the peers regarding the ASIIN-Criterion 7.1.

D-7.2 Diploma Supplement and qualification certificate

Analysis of Peers:

The FER provides subject specific Diploma Supplements for each study programme. These contain information as to the study objectives, the structure, level, content and status of the studies, the success of graduates as well as about the composition of the final grade. Still missing is a concise summary of the relevant learning outcomes illustrating the qualification profile of graduates of the respective study programme. The learning outcomes listed in the objectives matrices are far too long to serve this purpose, as has been indicated above (chapter B-2.2).

Furthermore, statistical data in addition to the final mark according to the ECTS Users' Guide or any regulation concerning the comparability of the individual final grade in the European Higher Education Area (EHEA) are not foreseen. Such data may assist in interpreting the individual degree.

Assessement of Peers; ASIIN-criterion 7.2:

The peers deem the requirements of the above cited criterion as not fulfilled sufficienctly yet. For reasons of transparency of the achieved competencies of graduates to potential stakeholders (like companies or other HEIs, in particular international ones) they consider it necessary to insert a succinct summary of relevant learning outcomes for each programme – and specialization of study, if needed. Along with that, in addition to the final grade an ECTS grading table according to the ECTS Users' Guide has to be inserted from their point of view, thus ensuring the (international) comparability of the grade.

Comment of the HEI:

Statement regarding the learning outcomes for undergraduate study programmes is included in response to ASIIN-Criterion 2.2. Regarding the second comment of the peers, related to inclusion of the ECTS Grading Table in the Diploma Supplement, we acknowledge that the current version of Diploma Supplement does not include this Table. The Diploma Supplement document is prepared by means of the Information Systems for HEI ("Informacijski sustav visokih ucilista - ISVU"). This is a national information system financed by the Ministry of Science, Education and Sports of the Republic of Croatia that is supported and administered by University Computing Center (SRCE). We have already issued a request for inclusion of the Grading Table to the ISVU support and development team, but have not received any confirmation yet regarding possible implementation date of this request.

E Final Assessment of the peers (March 7, 2013)

The peers welcome the **comments** given by FER (University of Zagreb). After thoroughly considering these comments they summarize their analysis and final assessment as follows:

Analysis of peers

- ASIIN criterion 1: The remarks on the acronyms of the degrees awarded are almost exclusively aimed at giving FER an indication to use short but meaningful titles according to the conventional European degrees. The utilisation of degrees according to national rules, of course, is understandable. Neither are any further comments necessary nor is any immediate action to be taken by the HEI.

- ASIIN criterion 2.2: The comment of the HEI confirms the impression the peers received through the information on the programmes presented in the SAR and in the audit talks. Admittedly, the Bachelor's thesis might be assigned to the chosen specialisation as well on a regular basis. But this does not very much alterate the argument that these programmes, at the undergraduate level at least, are interwoven by concept, what comes to the fore very clearly if one takes only into account the (intended) overlaps in fundamentals of Natural Sciences, Mathematics, Electrical Engineering and Computing subjects and related learning outcomes in the two Bachelor's programmes. Moreover, the HEIs argument does not lead any further in providing information on how the study specific objectives are achieved in the resp. curriculum (in other words, which modules refer to the resp. learning outcomes for the study programme as a whole).

  FER once again highlightens the flexibility it is aiming at with its closely affiliated study programmes at the undergraduate level. Graduates of the Bachelor's programmes should have a broad knowledge of Natural Science, Engineering and Computing fundamentals and, additionally, be prepared for flexibly continuing their studies in different Master's programme specialisation tracks. Nevertheless, these undergraduate and graduate programmes are designed to be clearly differentiated, aiming at learning outcomes which, to a substantial part at least, identify them as separated programmes. The closer the programmes are in content and intended learning outcomes, the more pressing is the need for programme specific learning outcomes and curricular designs that reasonably suit these objectives.

  The correlation and consonance of the programmes' names, the specialisation tracks, the respective learning outcomes and the curricular content must be demonstrated comprehensively in an objectives matrix for each study programme which reasonably reflects the hierarchy of learning outcomes. Unfortunately, the “flat model for description of learning outcomes” used in the SAR does not provide a traceable insight into the way learning outcomes at different levels (study programme and module related level) effectively correspond.

- ASIIN criterion 2.3: FER’s announcement to encourage the lecturers’ updating of the course descriptions is appreciable.
- ASIIN criterion 2.4: As to the recommendation to implement a mandatory industrial placement in the Bachelor’s programme Electrical Engineering and Information Technology the HEI’s argument in defense of offering such opportunities not until students enter the master level is understandable inasmuch FER expects almost all Bachelor graduates to commence a consecutive Master’s programme. Seen in the light of the objective, to provide graduates with the knowledge, skills and competencies necessary to be employed in a professional field that suits their qualifications profile, the HEI’s argument nevertheless is not at all convincing. Rather it is that very assumption that has primarily lead to the original recommendation of integrating such an industrial placement as a mandatory prerequisite not just at the master level but already at the Bachelor’s level in order to improve the ability of students to individually and responsibly conduct profession- and subject-related tasks in a company and thereby to improve their employability in general.
- ASIIN criterion 2.6: The explanations concerning the Bachelor’s Programme Computing given by FER clearly prove the Informatics related deficiancies in the curriculum of this programme to be the result of a conceptual approach aimed at students’ flexibility at the expense of disciplinary consistency and consequence. To conceive the currcent curriculum as a necessary precondition laying the proper foundations for all but the named Master’s programme specialisations is a direct consequence of the cross programme oriented conception of those Master’s programme “profiles”. Probably this might be avoided by a more disciplinary oriented curriculum development of the Electrical Engineering and Computing branches respectively, without being ignorant to the fact that these are higly interwoven in many modern application fields. Therefore, FER’s long-term plannings to implement two more distinct Bachelor’s curricula appear to be the most convincible solution to this conceptual problem.

  Otherwise, FER’s indication that such far-reaching curriculum modifications have to pass several approval processes, taking more time than would be allowed for the fulfilment of possible requirements in that direction, is to be seriously considered. The proposed short term adjustment to prelude a general revision of the curriculum of the Bachelor’s programme Computing (integration of a course *Object-oriented programming* replacing the course *Physics 2*) clearly points in the right direction. In addition, FER’s remarks on the core topics of Discrete Mathematics as already being treated in the current curriculum are traceable at least. Taken together, the proposed measures might be a short-term remedy for the curriculum shortcomings already indicated in this report.

- ASIIN criterion 3.2: FER states that periodic re-evaluation of credit point allocation is already integrated as one of the quality assurance processes. There is no further indication to doubt this notice.
- ASIIN criterion 4: With the additional information delivered by FER it is established that at least one of the examiners of the final thesis belongs to the body of full-time lecturers who deliver the programme. Furthermore, the national regulation FER refers leads to the assumption that, in principle, it does also apply for final thesises carried out externally.
- ASIIN criterion 7.2: Concerning the inclusion of *subject specific learning* outcomes in the Diploma Supplement it must be conceded that the related assessment in this report should have been more directly linked to the process of revision and, possibly, reformulation of those objectives in the course of clarification of the learning objectives at different hierarchical levels as requested below in requirement 1. FER plausibly refers to the acknowledgement of these learning outcomes in the first ASIIN accredition back in academic year 2005/2006. But reviewing the intended learning objectives for each programme as well as demonstrating their viability through the respective curricula and also the subject specific distinctiveness of the the programmes might lead to adaptations which should be reflected in the respective Diploma Supplement.

  With respect to displaying an ECTS grading table or statistical data in accordance with the ECTS Users' Guide in order to assist in interpreting the individual degree, the measures already been taken by FER are deemed to be constructive.

Final assessment of peers

ASIIN criterion 2.2: With respect to the peers' analysis stated above, there is no reason to alter this part of the respective requirement concerning the intended learning objectives which the peers deemed necessary at the time of the audit visit (see below requirement 1, first part).

ASIIN criterion 2.4: With respect to the peers' analysis stated above, there is no reason to alter the proposed recommendation on implementing a mandatory industrial placement in the Bachelor's programme Electrical Engineering and Information Technolgy (see below recommendation 5).

ASIIN criterion 2.6: Since the inclusion of the course Object-oriented programming in the Bachelor's programme Computing only constitutes a proposal and is not a mandatory element in the curriculum as yet, peers still deem a requirement with respect to the fundamentals of Informatics necessary (see below requirement 4). Additionally, they strongly support FER's curriculum revision plannings in order to achieve the intended study goals more consistently. They therefore propose adding a recommendation supporting the said intentions of FER (see below recommendation 6).

ASIIN criterion 3.2: Peers deem it no longer necessary to particularly advice FER conducting continual evaluation and – if necessary – adjustment of credit point allocation. They therefore consider a correspondent recommendation dispensible.

ASIIN criterion 4: Because of FER's additional information on national regulation applying to the examiner of the final thesis and the supervision of final thesises carried through externally, the peers consider a requirement with regard to the related demands no longer necessary.

ASIIN criterion 7.2: With respect to the peers' analysis stated above, a clarification of this part of the related requirement seems to be necessary. Thus, the reference to reflecting alterations of the learning outcomes for each study programme in the Diploma Supplement as well is more directly expressed (see below requirement 1, last part).

Except for the explicitly stated alterations, the peers confirmed their judgments in this report and in particular the requirements and recommendations which have been provisionally drafted by the time of the onsite visit.

The peers recommend the award of the requested seals as described hereafter:

Degree Programme	ASIIN-seal	Subject-Specific label[1]	Accreditation valid until (max.)
Ba Electrical Engineering and Information Technology	with requirements	EUR-ACE®	30.09.2018
Ma Electrical Engineering and Information Technology	with requirements	EUR-ACE®	30.09.2018
Ma Information and Communication Technology	with requirements	EUR-ACE®	30.09.2018
Ba Computing	with requirements	Euro-Inf® - upon fulfilment of requirements -	30.09.2018
Ma Computing	with requirements	Euro-Inf®	30.09.2018

Requirements and recommendations for the requested seals and labels

Requirements	ASIIN
For all degree programmes	
1. It is required that the name of the study programme, the name of specialization tracks, and the corresponding learning outcomes (in terms of "qualification profiles") as well as the study content have to be made consonant with each other. This coherence must be plausibly demonstrated in the goal matrix for each programme. Furthermore, study aims and intended learning outcomes must be made accessible to the relevant stakeholders, in particular students and lecturers, in such way that students are able to appeal to them (for example in the course of internal quality	2.2, 7.2

[1] Requirements / recommendations and terms for Subject-Specific labels always correspond to the ASIIN-seal.

assurance processes). Any adjustment in the course of revising the learning outcomes needs to be reflected in the Diploma Supplement as well.	
2. In addition to the final grade, an ECTS grading table or statistical data according to the ECTS Users' Guide have to be provided so as to ensure the international comparability of the achieved final grade.	7.2
For the <u>Bachelor's programme Computing</u>	
3. It is necessary to adjust the curriculum in such a way that students achieve more competencies in the fundamentals of Informatics and related basics (like Discrete Mathematics, formal methods, modelling etc.) at the intended level of qualification.	2.6
Recommendations	**ASIIN**
For all degree programmes	
1. It is recommended to further develop the quality assurance concept of the study programmes under consideration and to use the data gathered and evaluated for continual improvements. Moreover, employment of students upon completing their degrees should be systematically surveyed in order to allow conclusions as to the extent the study objectives and quality expectations of the HEI have been fulfilled.	6.1, 6.2
2. It is recommended that teacher's participation in international exchange programmes as well as consultation of external (international) experts in staff recruitment processes should be encouraged through adequate means.	5.3
3. It is recommended to reconsider the allocation of credit points to non-academic "Skills" courses.	2.6, 3.2
4. It is recommended to implement appropriate means for further development of the professional knowledge and teaching skills of staff.	5.2
For the <u>Bachelor's programme Electrical Engineering and Information Technology</u>	
5. It is recommended to implement a mandatory industrial placement for all students in order to improve their ability to individually and responsibly conduct profession- and subject-related tasks in a company.	2.4
For the Bachelor's Programme Computing	
6. It is recommended to proceed with the revision of the curriculum as proposed so as to further strengthen the Informatics related fundamental compentencies of students.	2.6

F Comments of the Technical Committees

F-1 Technical Committee 02 – Electrical Engineering and Information Technology (March 8, 2013)

The Technical Committee discusses the procedure. Meanwhile, peers have arrived at a majority vote confirming the draft version that has been proposed to the Technical Committee.

For the award of the ASIIN seal:

The Technical Committee fully agrees with the requirements and recommendations proposed by the peers.

For the award of the EUR-ACE® Label:

The Technical Committee deems that the intended learning outcomes of the Bachelor's and the Master's programme Electrical Engineering and Information Technology and the Master's Programme Information and Communication Technology do comply with the engineering specific part of its Subject-Specific Criteria. Therefore, it recommends the award of the EUR-ACE® label to the said programmes.

The Technical Committee 02 – Electrical Engineering and Information Technology recommends the award of the requested seals as described hereafter:

Degree Programme	**ASIIN-seal**	**Subject-Specific label**	**Accreditation valid until (max.)**
Ba Electrical Engineering and Information Technology	with requirements	EUR-ACE®	30.09.2018
Ma Electrical Engineering and Information Technology	with requirements	EUR-ACE®	30.09.2018
Ma Information and Communication Technology	with requirements	EUR-ACE®	30.09.2018
Ba Computing	with requirements	Euro-Inf® - upon fulfilment of requirements -	30.09.2018
Ma Computing	with requirements	Euro-Inf®	30.09.2018

F-2 Technical Committee 04 – Informatic/Computer Science (March 11, 2013)

The Technical Committee discusses the procedure. It confirms the requirements and recommendations proposed by the peers.

For the award of the ASIIN seal:

The Technical Committee fully agrees with the requirements and recommendations proposed by the peers.

For the award of the Euro-Inf® Label:

The Technical Committee deems the intended learning outcomes of the Bachelor's and Master's programme Computing principally complying with its Subject-Specific Criteria. Nevertheless, it considers the achievement of the learning outcomes for the Bachelor's programme Computing being affected by the fact that some Informatics related fundamentals are provided or decively deepened not until starting with the master level. Therefore, the Technical Committee recommends awarding the Euro-Inf® Label to the Master's programme Computing but at the same time postponing the awarding of the label to the Bachelor's programme Computing until the shortage in informatics fundamentals field has been reasonably removed.

The Technical Committee 04 – Informatics/Computer Science recommends the award of the requested seals as described hereafter:

Degree Programme	**ASIIN-seal**	**Subject-Specific label**	**Accreditation valid until (max.)**
Ba Electrical Engineering and Information Technology	with requirements	EUR-ACE®	30.09.2018
Ma Electrical Engineering and Information Technology	with requirements	EUR-ACE®	30.09.2018
Ma Information and Communication Technology	with requirements	EUR-ACE®	30.09.2018
Ba Computing	with requirements	Euro-Inf® - upon fulfilment of requirements -	30.09.2018
Ma Computing	with requirements	Euro-Inf®	30.09.2018

G Decision of the Accreditation Commission (March 22, 2013)

The Accreditation Commission discusses the procedure. It fully agrees with the assessment of the peers and Technical Committees.

Assessment for the award of the ASIIN seal:

The Accreditation Commission decides on requirements and recommendations for the degree programmes as proposed by the peers and Technical Committees.

Assessment for the award of the EUR-ACE® Labels:

The Accreditation Commission considers the intended learning outcomes of the Bachelor's and the Master's programme Electrical Engineering and Information Technology and the Master's Programme Information and Communication Technology complying with the engineering specific part of the Subject-Specific Criteria of the Technical Committee 02 – Electrical Engineering and Information Technology. The Accreditation Commission also deems the curricula of the said programmes suited to achieve these learning objectives. It therefore concludes awarding the EUR-ACE® label to the said programmes.

Assessment for the award of the Euro-Inf® Labels:

The Accreditation Commission deems the intended learning outcomes of the Bachelor's and Master's programme Computing principally complying with the Subject-Specific Criteria of the Technical Committee 04 – Informatics/Computer Science. Concerning the Master's programme it also deems the resp. curriculum suited to achieve the said learning objectives. Otherwise, with respect to the Bachelor's programme it considers the achievement of the learning outcomes being potentially affected by the fact that some Informatics related fundamentals are provided or decisively deepened not until starting with the master level. All in all, the Accreditation Commission concludes awarding the Euro-Inf® Label to the Master's programme Computing while at the same time postponing the awarding of the label to the Bachelor's programme Computing until the shortage in the informatics fundamentals field has been reasonably removed.

The Accreditation Commission for Study Programmes decides on the award of the requested seals as described hereafter:

Degree Programme	**ASIIN-seal**	**Subject-Specific label**	**Accreditation valid until (max.)**
Ba Electrical Engineering and Information Technology	with requirements for one year	EUR-ACE®	30.09.2018
Ma Electrical Engineering and Information	with requirements	EUR-ACE®	30.09.2018

Degree Programme	ASIIN-seal	Subject-Specific label	Accreditation valid until (max.)
Technology	for one year		
Ma Information and Communication Technology	with requirements for one year	EUR-ACE®	30.09.2018
Ba Computing	with requirements for one year	Euro-Inf® - upon fulfilment of requirements -	30.09.2018
Ma Computing	with requirements for one year	Euro-Inf®	30.09.2018

Requirements and recommendations concerning the requested seals:

Requirements	ASIIN
For all degree programmes	
1. It is required that the name of the study programme, the name of specialization tracks, and the corresponding learning outcomes (in terms of "qualification profiles") as well as the study content have to be made consonant with each other. This coherence must be plausibly demonstrated in the goal matrix for each programme. Furthermore, study aims and intended learning outcomes must be made accessible to the relevant stakeholders, in particular students and lecturers, in such way that students are able to appeal to them (for example in the course of internal quality assurance processes). Any adjustment in the course of revising the learning outcomes needs to be reflected in the Diploma Supplement as well.	2.2, 7.2
2. In addition to the final grade, an ECTS grading table or statistical data according to the ECTS Users' Guide have to be provided so as to ensure the international comparability of the achieved final grade.	7.2
For the <u>Bachelor's programme Computing</u>	
3. It is necessary to adjust the curriculum in such a way that students achieve more competencies in the fundamentals of Informatics and related basics (like Discrete Mathematics, formal methods, modelling etc.) at the intended level of qualification.	2.6

Recommendations	ASIIN
For all degree programmes	
1. It is recommended to further develop the quality assurance concept of the study programmes under consideration and to use the data gathered and evaluated for continual improvements. Moreover, employment of students upon completing their degrees should be systematically surveyed in order to allow conclusions as to the extent the study objectives and quality expectations of the HEI have been fulfilled.	6.1, 6.2
2. It is recommended that teacher's participation in international exchange programmes as well as consultation of external (international) experts in staff recruitment processes should be encouraged through adequate means.	5.3
3. It is recommended to reconsider the allocation of credit points to non-academic "Skills" courses.	2.6, 3.2
4. It is recommended to implement appropriate means for further development of the professional knowledge and teaching skills of staff.	5.2
For the <u>Bachelor's programme Electrical Engineering and Information Technology</u>	
5. It is recommended to implement a mandatory industrial placement for all students in order to improve their ability to individually and responsibly conduct profession- and subject-related tasks in a company.	2.4
For the <u>Bachelor's Programme Computing</u>	
6. It is recommended to proceed with the revision of the curriculum as proposed so as to further strengthen the Informatics related fundamental compentencies of students.	2.6