**Course-specific examination regulations for the Master programme in "Functional Safety Engineering" at the Department of Electrical Engineering and Computer Science of the University of Kassel dated May 9, 2018**

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## § 1 Scope of Application

The course-specific examination regulations for the consecutive Master programme “Functional Safety Engineering“ in English language at the Department of Electrical Engineering and Computer Science supplement the general provisions for Subject Area Examination Rules for Degrees at the Bachelor’s and Master’s Level at the University of Kassel (general conditions Master and Bachelor) within the respectively valid version.

## § 2 Profile Type, Academic Degree

The Master programme “Functional Safety Engineering” represents a more research-oriented profile type. Upon passing the examination the candidate shall be awarded the “Master of Science” degree (abbr. M.Sc.) by the Department of Electrical Engineering and Computer Science.

## § 3 Start of Studies, Standard Duration of Studies, Extent of Studies

(1) The Master course of study can be taken up in winter term only.
(2) The standard duration of studies for the Master course is three semesters including the Master thesis and colloquium.

(3) A total of 90 credits shall be acquired in the Master Course.

## § 4 Examination Committee

The Board of Examiners of the Master programme “Functional Safety Engineering” is authoritative for the decision of exam related issues. The Board of Examiners comprises of:
a) three professors of faculty 16,
b) one scientific assistant of faculty 16 and
c) one student of the Master programme “Functional Safety Engineering”.

## § 5 Admission Requirements

(1) Eligible for admission to the Master’s programme is who
a) has passed the Bachelor examination or the diploma I examination in electrical engineering, computer science, mathematics or mechatronics at the University of Kassel or
b) has acquired an equivalent qualified degree in the subject area Electrical Engineering from another University or University of Applied Sciences in Germany or from a University that is equivalently recognized abroad including a standard period of study of at least seven semesters and has acquired 210 credits. Or
c) has acquired a subject-related at least equivalent degree from another University or University of Applied Sciences in Germany or from a University that is equivalently recognized abroad including a minimal standard period of study of at least six semesters and has accomplished 180 credits. In this case the qualification constraints of § 5 section (3) shall apply.

(2) Furthermore, evidence of sufficient knowledge of the English language level B2, as defined in the Common European Framework of Reference for Languages, must be documented. This evidence is only required if the applicant’s native language is not English or if the teaching language used in the programme, which led to the first academic degree, has not been English.

(3) If the applicant does not fulfil all prerequisites for an admission to the Master course of studies,

the Board of Examiners may take provisions for an admission under the condition of producing the missing skills and knowledge before registering for Master thesis by successfully passing modules to the extent of 30 credits from the following list:

| Module title | Credits |
|---|---|
| Project at the Department Computer Architecture and System Programming | 8 |
| Seminar at the Department Computer Architecture and System | 4 |
| Computer Architecture | 6 |
| Microprocessor Technology and Embedded Systems I | 6 |
| System Programming | 6 |

In order to pass the additional modules the duration of study can extend the Master studies by one semester.

## § 6 Examination Components, Module Examinations

(1) Study-accompanying module examinations shall be offered in time- and subject-based context of the modules.
(2) The examination components may comprise the following types of examination:

- Written examination/exam (60-180 minutes),
- Oral examination (20-40 min.),
- Term paper (15-20 pages),
- Presentation (30-45 min.),
- Project work (30-60 pages),
- Internship report (approx. 20 pages).

The type of examination of a module or submodule is determined within the framework of the study- and exam scheme by the lecturer right at the beginning of the course to which the examination relates.

(3) The study-accompanying module examinations during the course of study may also consist of several partial module examinations (submodule examination components). The module is considered as passed if all courses included in the module have been graded with “sufficient” (4.0) performance at least.

(4) Failed module examinations can be repeated twice. Passed module examinations may not be repeated. In the case of a failed module examination in which the module examination consists of several submodule examinations, those submodule examinations which have been failed and graded as “insufficient” can be repeated twice. It is not permitted to repeat partial module examinations that have been passed in first attempt.

(5) The module examination can be taken in English or in another language in agreement with the examiner.

(6) Group work that involves a maximum of three candidates can be accepted. The different parts of the group work of the different persons in charge have to be clearly defined and it has to be possible to evaluate the individual effort.

## § 7 Examination Components of the Master Degree

(1) Thematic priorities are set within the framework of the Master programme regarding one of these key areas:

- System and Control
- Mathematical Models and Software Technology
- Sensor and Communication
- Biomedical Engineering
- Safety Structures for Vehicles

(2) The Master examination consists of the module examinations of the compulsory modules in accordance with paragraph 3, the module examinations of the focus modules according to paragraph 4 and of the Master module in accordance with § 8.

(3) Compulsory modules with corresponding credits:

| **Module title** | **Credits** |
|---|---|
| Mathematical models for safety systems | 6 |
| Selected topics on programming languages and techniques according to IEC 61131-3 | 6 |
| Theory of safety-related computer architectures | 6 |
| Introduction to information theory and coding | 6 |
| Safety standards and norms of electronic systems | 6 |
| Project | 8 |
| Seminar | 4 |

(4) The focus modules, which should lead to 18 credits, have to be taken from one of the chosen key areas:

a) The key area “System and Control” includes
- Advanced Digital Control (6 credits)
- Computer based Design of Microelectronic Circuits (6 credits)
- Functional Safety in Computer Architectures (6 credits)
- Process Computing (6 credits)
- Reconfigurable Structures
- Risk Determination of Computer Architectures (6 credits)
- Selected Topics on Microprocessor Techniques (6 credits)

b) The key area “Mathematical Models and Software Technology” includes
- Functional Safety in Computer Architectures (6 credits)
- Methods for Automation for Safety-related Systems (6 credits)
- Methods for Software Reliability and Software Quality (6 credits)
- Pattern Recognition (6 credits)
- Reliability Models and Software Architecture for Complex Systems (6 credits)
- Risk Determination of Computer Architectures (6 credits)
- Verification of Embedded Systems (6 credits)

c) The key area “Sensor and Communication” includes
- Functional Safety in Computer Architectures (6 credits)
- Introduction to Signal Detection and Estimation (6 credits)
- Semiconductor Lasers (6 credits)
- Optical Communication Systems (6 credits)
- RF Sensor Systems (6 credits)
- Risk Determination of Computer Architectures (6 credits)

d) The key area “Biomedical Engineering” includes

- Functional Safety of Biomedical Systems
- Biomedical Engineering
- Biomedical Instrumentation
- Selected Topics of Biomedical Engineering

d) The key area “Safety Structures for Vehicles” includes

- Safety Electronic Systems in Vehicles (6 credits)
- Mathematical Safety Analysis of Electronic Systems in Cars (6 credits)
- Modeling of Safety Structure according to ISO 2626-2 (6 credits)
- Modeling of Safety Architectures in Automotive (6 credits)

(5) The compulsory modules (paragraph 3) and the focus modules (paragraph 4) are successfully completed when in total 60 credits have been attained. Any additional credits produced from these areas can be taken into account up to a maximum of 18 credits and would be assigned to the additional courses taken. The assignment of the modules to these areas shall take place at the latest when the registration for Master thesis is filed.

(6) In the framework of the Master course integrated key competences to the extent of at least 9 credits must be produced. This includes the Master thesis and the colloquium (6 credits), presentations and term papers respectively (3 credits).

## § 8 Master Module

(1) The Master thesis and the colloquium form the Master module. A total of 30 credits will be awarded for the Master module.

(2) Only who can evidence the successful completion of full modules to the extent of 48 credits is eligible to file for Master thesis.

(3) The topic of the Master thesis shall be assigned by the Board of Examiners. Along with the assignment of the Master thesis the Board of Examiners appoints the first examiner who shall supervise the Master thesis, and the second examiner. The first examiner has to be a member of the faculty of Electrical Engineering/Computer Science.

(4) The candidate may submit proposals for the topic of the Master thesis and the examiners.

(5) The duration for writing the Master thesis from the intitiation of the topic to the submission date is 22 weeks and starts with the day of the assignment of the thesis topic. The topic of the Master thesis can be dismissed only once and solely within the first four weeks after filing.

(6) At the candidate´s request, and with the agreement of the first examiner, the Master thesis can also be written another language than English.

(7) In the case that the initial submission deadline cannot be kept due to reasons that the candidate cannot be held responsible, the Board of Examiners may grant a one-time extension of the time to complete the thesis if the candidate requests it before the submission line passes and the supervisor agrees for no longer than 11 weeks.

(8) The Master thesis has to be submitted within the prescribed period in two bound copies as well as in electronic form stored on a data carrier medium to the Board of Examiners.

(9) The Master´s thesis has to be presented within the framework of a master colloquium. Apart from the candidate at least the first examiner or the second grader and an observer have to participate in the colloquium. After handing in the Master´s thesis, the colloquium is to be held within ten weeks. Admission to that colloquium requires that the Master thesis was graded at least as "sufficient". The period provided for the colloquium is 30 to maximum 60 minutes.

(10) The Master´s examination is passed if the Master thesis and the colloquium were graded as at least „sufficient".

(11) The final grade of the Master thesis results from the evaluation result of the written work (weighting three fourths) and the evaluation result of the colloquium (weighting one-fourth). The colloquium may be repeated once if it has not been graded as at least "sufficient". The first and the second examiner have to be present when the colloquium is retaken. If the retaken colloquium is graded as "insufficient", the Master module is going to be graded as "insufficient" as well and the candidate would have failed.

(12) The Master´s thesis may, in agreement with the first or the second grader and the chairman of the examination committee, be written outside of the university. In that case, the first examiner and the second grader have to be members of the faculty of electrical engineering/computer science. The provisions of paragraphs 1 to 11 do also apply to the externally written Master´s thesis.

## § 9 Grading of the Modules and Overall Grade

(1) The overall grade of a module results from the weighted arithmetic mean of the grades, weighted by the credits, basing on the course units, which were chosen to be part of the module. Any test achievement that is chosen to be integrated into the module has to be passed with "sufficient" mark at least.

(2) In accordance with § 7 paragraph 2, the overall grade of the Master´s examination does result from the weighted arithmetic mean of the grades of the modules, which is weighted by the credits.

## § 10 Coming Into Effect

These examination regulations shall enter into force on the day following their announcement in the bulletin of the University of Kassel.

Done at Kassel on June 26, 2018

Dean of the Electrical Engineering/Computer Science Department
Prof. Dr. -Ing. Axel Bangert

**Starting in winter term**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WS | Mathematical Models for Safety Systems | | | | | | Selected topics on Programming languages and techniques according to IEC 61131-3 | | | | | | Theory of Safety-related computer architectures | | | | | | Introduction to information theory and coding | | | | | | Safety standards and norms of electronic systems | | | | | |
| 2 | SS | Project | | | | | | | | Seminar/Lectures | | | | Focus modules (18CP)<br>(refer to the module manual chapter 2) | | | | | | | | | | | | | | | | | | |
| 3 | WS | Master's thesis (22 weeks) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

The light grey parts are referred to as the integrated key competencies

Appendix 1 Study- and Exam Scheme

1. Compulsory Modules

| Module name | Mathematical Models for Safety Systems |
|---|---|
| Type of module | Compulsory |
| Learning results, competencies, qualification goals | The student is able to<br>- Derive and apply mathematical procedures, models and methods for functional safety and reliability<br>- Explain and evaluate the usability of mathematical models for different functional safety system structures<br>- Determine, derive, interpret and analyze different relevant safety parameters to assess functional safe and reliable applications<br>- Model, analyze and evaluate mathematically different safety architectures<br>- Use and interpret different methods and concepts in order to derive and determine mathematically safety parameters<br><br>Learning results with regard to the objectives of the course of study:<br>- Gaining a deeper Knowledge of continuous and discrete distributions and the ability to apply it in the field of functional safety and reliability<br>- Gaining a deeper Knowledge of special distributions like the Weilbull distribution and the ability to apply it in the field of functional safety and reliability<br>- Gaining a deeper Knowledge of special estimation procedures like the Maximum Likelihood Estimation and the ability to apply it in the field of functional safety and reliability<br>- Gaining a deeper Knowledge of Markov-Chains and Markov-models in order to determine Parameters (MTTF, etc) to be used in functional safety and reliability<br>- Gaining a deeper Knowledge of theoretical probability analyses methods to determine PFD- and PDH values for systems to be used in functional safety<br>- Confidently applying and determine of the above described methods when modelling mathematically safety relevant systems |
| Types of courses | 4 SWS (semester periods per week): 2 SWS lecture<br>2 SWS exercise |
| Requirements for the participation in the module | None |
| Student workload | 180 h: 60 h attendance studies<br>120 h personal studies |
| Academic performances | None |
| Precondition for the admission to the examination performance | None |
| Examination performance | Written exam 120-180 min. or oral exam 20-40 min, depending on the number of participants |
| Number of credits of the module | 6 credits |

| | |
|---|---|
| **Module name** | **Selected topics on Programming languages and techniques according to IEC 61131-3** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- develop and test programs, function blocks and functions according to the international standard IEC 61131-3,<br>- explain the functionality of the language elements,<br>- organize, classify and analyze programme sequences by means of the standard IEC 61131-3,<br>- develop, analyze and evaluate safety structures and overserving units<br>- document and evaluate formal results in a discerning way.<br>Learning results with regard to the objectives of the course of study:<br>- Gaining a deeper knowledge in the development of reliable programming structures<br>- Gaining a deeper knowledge in systematic development and verification of programs<br>- Gaining a deeper knowledge in the analysis and validation of observing structures and diagnostic measurements |
| **Types of courses** | 4 SWS (semester periods per week): 2 SWS lecture<br>2 SWS exercise |
| **Requirements for the participation in the module** | None |
| **Student workload** | 180 h: 60 h attendance studies<br>120 h personal studies |
| **Academic performances** | Academic performance: 2 documentations/reports of 6-10 pages in accordance with the pre-specified format |
| **Precondition for the admission to the examination performance** | None |
| **Examination performance** | Examination performance: electronic exam (including a programming task) 120-180 min. |
| **Number of credits of the module** | 6 credits |

| | |
|---|---|
| **Module name** | **Theory of safety related computer architectures** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- Analyze and evaluate different norm conform determined architecture models (IEC 61508, IEC62016, ISO26262, ISO13849)<br>- Analyze and evaluate properties of safety computer architectures<br>- Derive and analyze reliability and safety parameters for different safety architecture models<br>- Analyze and evaluate diagnostic proof and tests methods for safety related architectures<br>Learning results with regard to the objectives of the course of study:<br>- Gaining a deeper knowledge of models for safety architectures and structures<br>- Gaining a deeper knowledge on how to analyzes safety related architecture models in order to determine failure probabilities<br>- Gaining a deeper knowledge in determine reliability parameters for different safety related architectures<br>- Gaining a deeper knowledge of special M of N structures for safety systems<br>Gaining a deeper knowledge of diagnostic, proof and test structures for architecture model for safety systems |
| **Types of courses** | 4 SWS (semester periods per week): 2 SWS lecture<br>2 SWS exercise |
| **Requirements for the participation in the module** | Prerequisites according to examination regulations |
| **Student workload** | 180 h: 60 h attendance studies<br>120 h personal studies |
| **Academic performances** | None |
| **Precondition for the admission to the examination performance** | None |
| **Examination performance** | Written or oral exam (120 minutes) or term paper 15-20 pages, will be announce in the lecture |
| **Number of credits of the module** | 6 credits |

| | |
|---|---|
| **Module name** | **Introduction to information theory and coding** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- apply knowledge about the fundamental relationships within the information theory,<br>- develop and apply optimal and suboptimal procedures for block coding and convolutional coding and decoding,<br>- create and apply optimal and suboptimal procedures for the coding and decoding of sources.<br><br>Learning results with regard to the objectives of the course of study:<br>- Gaining a deeper knowledge about the specific electrical basics.<br>- Acquiring enhanced and applied subject-specific basics.<br>- Identifying and classifying complex electro-technical and interdisciplinary tasks.<br>-Being confident in the ability to use and evaluate analytical methods.<br>-Being able to create and evaluate solving methods independently.<br>-Gaining important and profound experience in the area of practical technical and engineering skills.<br>- Working and researching in national and international contexts. |
| **Types of courses** | 4 SWS (semester periods per week): 3 SWS lecture and exercise<br>1 SWS exercise practical training |
| **Requirements for the participation in the module** | None |
| **Student workload** | 180 h: 60 h attendance studies<br>120 h personal studies |
| **Academic performances** | Exercise practical training |
| **Precondition for the admission to the examination performance** | Exercise practical training |
| **Examination performance** | Oral examination 30 min. |
| **Number of credits of the module** | 6 credits<br>Lecture 5 credits<br>Exercise practical training 1credit |

| | |
|---|---|
| **Module name** | **Safety standards and norms of electronic systems** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- Understand the development and structure of norms (type A,B,C) and derivatives (Seveso)<br>- Differentiate, refer and apply base norms (IEC 61508) and specific sector norms (IEC 61513)<br>- Understand and apply international norms in various industrial fields (IEC 61511 for process industries, ISO 13849 for machinery )<br>- Deviate the entire safety life cycle of a development of a safety related system according to IEC 61508 and the entire development cycle in its single phase and furthermore, to define the necessary tasks for the development.<br>- Understand and apply procedure and methods to certify safety systems according to international norms (IEC 61508)<br>Learning results with regard to the objectives of the course of study:<br>- Is to understand norms, its organizations, procedures for norms, structures of organizations of different international standardization's committees<br>- Gaining a deeper knowledge of fundaments of safety technique (VDI 40022, IEC 61508) and strategic management of safety<br>- Gaining a deeper knowledge of functional safety management<br>- Gaining a deeper knowledge of the life cycle model according to IEC 61508 and the sectoring of SIL levels<br>- Gaining a deeper knowledge of planning of the necessary task for verification and validation according to IEC 61508 |
| **Types of courses** | 4 SWS (semester periods per week): 2 SWS lecture<br>2 SWS exercise |
| **Requirements for the participation in the module** | Prerequisites according to examination regulations |
| **Student workload** | 180 h: 60 h attendance studies<br>120 h personal studies |
| **Academic performances** | None |
| **Precondition for the admission to the examination performance** | None |
| **Examination performance** | Written exam 120-180 min. or oral exam 20-40 min. depending on the number of participants and will be announce in the lecture |
| **Number of credits of the module** | 6 credits |

| | |
|---|---|
| **Module name** | **Seminar** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- apply the expertise learnt during the studies on a defined problem task<br>- develop an own theme from literature and original work written in English<br>- apply scientific methods on scientific work e.g. questioning statements, providing own opinions, evaluate statements, using secondary literature und the ability to gather information from various sources<br>- present in a structured way research topics using appropriate oral and written forms |
| **Types of courses** | 2 SWS (semester periods per week) : seminar |
| **Requirements for the participation in the module** | Prerequisites according to examination regulations |
| **Student workload** | 180 h: 60 h attendance studies<br>120 h personal studies |
| **Academic performances** | None |
| **Precondition for the admission to the examination performance** | None |
| **Examination performance** | Written elaboration (30-60 pages) and presentation (30-45 minutes) |
| **Number of credits of the module** | 4 credits |

| | |
|---|---|
| **Module name** | **Project** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- apply problem-oriented the learnt knowledge presented in the program<br>- apply the learnt scientific methods presented in the program<br>- analyze challenging problems and solve it also with other students together<br>- develop unaided a project plan and time management und apply on time<br>- work out and reflect in a team questions on work organization, solve appearing conflicts and reflect the own work in business oriented and society oriented context<br>- develop (depending on the selected topic) specialized required Knowledge from literature find out interdisciplinary context |
| **Types of courses** | 4 SWS (semester periods per week): project |
| **Requirements for the participation in the module** | Prerequisites according to examination regulations |
| **Student workload** | 180 h: 60 h attendance studies<br>120 h personal studies |
| **Academic performances** | None |
| **Precondition for the admission to the examination performance** | None |
| **Examination performance** | Written elaboration (30-60 pages) and presentation (30-45 minutes) |
| **Number of credits of the module** | 8 credits |

| | |
|---|---|
| **Module name** | **Master Module** |
| **Type of module** | Compulsory |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- apply problem-oriented the learnt knowledge presented in the program<br>- apply the learnt scientific methods presented in the program<br>- develop and evaluate solutions without help<br>- work into new and also interdisciplinary scientific areas and evaluate the derived solutions<br>- to solve a scientific or praxis-oriented problem with scientific methods and knowledge within the timeframe stated in examination regulations and in conjunction with the self-developed project plan and time plan<br>- present and document the used methodology and results of the master's thesis in a clear and understandable manner<br>defend the results of the master's thesis in a scientific discussion |
| **Types of courses** | Master module |
| **Requirements for the participation in the module** | See examination regulations § 8 para. 1 |
| **Studentischer Arbeitsaufwand** | 880 h |
| **Student workload** | None |
| **Precondition for the admission to the examination performance** | See examination regulations § 8 para. 1 |
| **Examination performance** | Graded final thesis weighing three-fourths, presentation of the research work within the framework of a colloquium weighing one quarter |
| **Number of credits of the module** | 30 credits and 6 credits of them apply to the integrated key competencies |

Focus module "System and Control"

| | |
|---|---|
| **Module name** | **System and Control** |
| **Type of module** | Focus module |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- understand the different system structures and architectures of the functional safety and to use it in different application areas,<br>- derive and analyse techniques and methods for the modelling and for the functional safety of system structures,<br>- derive and create requirements and specifications for safety-related system architectures according to various international standards,<br>- apply and to distinguish between general and sector-specific standards of the functional safety,<br>- name and apply the different methods, models and approaches for the analysis, the modelling and evaluation of safety architectures and system structures. |
| **Types of courses** | VL+Ü, VL+P, P, S (lecture+ exercise, lecture+ project, project, seminar)<br>4 SWS (semester periods per week) |
| **Requirements for the participation in the module** | None |
| **Student workload** | 180 h |
| **Academic performances** | None |
| **Precondition for the admission to the examination performance** | Solve a theoretical task dealing with regulations including implementation,<br>giving a seminar presentation,<br>writing a term paper,<br>participating in all presentations and dealing with a report, exercises, tests, result report, attestation, final discussion, laboratory tasks, lectures, oral examination, term paper |
| **Examination performance** | 90 minutes for the presentation followed by a discussion,<br>oral examination 20-40 min.,<br>written examination 60-180 min.,<br>writing a term paper and giving a presentation,<br>graded term paper |
| **Number of credits of the module** | 6 credits |

Focus module "Mathematical models and Software technology"

| Module name | Mathematical Models and Software Technology |
|---|---|
| Type of module | Focus module |
| Learning results, competencies, qualification goals | The student is able to:<br>- understand and apply mathematical modelling and software strategies for safety-related systems in the various safety -relevant spheres of application,<br>- derive and analyse mathematical procedures and methods for complex safety structures,<br>- derive and create requirements and specifications for mathematical models and software structures in safety-relevant system structures,<br>- apply and to distinguish between various general and sector-specific calculation models, calculation methods as well as software technology approaches and software models,<br>-name and apply the different mathematical modelling techniques as well as the different methods of the software technology with regard to the functional safety. |
| Types of courses | VL+Ü, VL+P, P, S (lecture+ exercise, lecture+ project, project, seminar)<br>4 SWS (semester periods per week) |
| Requirements for the participation in the module | None |
| Student workload | 180 h |
| Academic performances | None |
| Precondition for the admission to the examination performance | Solve a theoretical task dealing with regulations including implementation,<br>giving a seminar presentation,<br>writing a term paper,<br>participating in all presentations and dealing with a report, exercises, tests, result report, attestation, final discussion, laboratory tasks, lectures, oral examination, term paper |
| Examination performance | 90 minutes for the presentation followed by a discussion,<br>oral examination 20-40 min.,<br>written examination 60-180 min.,<br>writing a term paper and giving a presentation,<br>graded term paper |
| Number of credits of the module | 6 credits |

Focus module “Sensor and Communication”

| Module name | Sensor and Communication |
|---|---|
| Type of module | Focus module |
| Learning results, competencies, qualification goals | The student is able to:<br>- understand and apply sensor structures and sensor design together with various filter procedures and communication structures in the context of functional safety and reliability,<br>- derive and analyse the different structures, models and procedures of sensor technology, data acquisition, filtering and communication;<br>- analyse and evaluate the various designs, procedures and techniques of the sensor technology, data acquisition, filtering and data transfer from the angle of functional safety and be able to derive requirements in accordance with international standards;<br>- apply and to distinguish between general and sector-specific standards of the functional safety;<br>- apply and analyse different methods, analyses, models and procedures of data acquisition, sensor technology, filtering and data transmission (communication). |
| Types of courses | VL+Ü, VL+P, P, S (lecture+ exercise, lecture+ project, project, seminar)<br>4 SWS (semester periods per week) |
| Requirements for the participation in the module | None |
| Student workload | 180 h |
| Academic performances | None |
| Precondition for the admission to the examination performance | Solve a theoretical task dealing with regulations including implementation,<br>giving a seminar presentation,<br>writing a term paper,<br>participating in all presentations and dealing with a report, exercises, tests, result report, attestation, final discussion, laboratory tasks, lectures, oral examination, term paper |
| Examination performance | 90 minutes for the presentation followed by a discussion,<br>oral examination 20-40 min.,<br>written examination 60-180 min.,<br>writing a term paper and giving a presentation,<br>graded term paper |
| Number of credits of the module | 6 credits |

Focus module "Biomedical Engineering"

| | |
|---|---|
| **Module name** | **Biomedical Engineering** |
| **Type of module** | Focus module |
| **Learning results, competencies, qualification goals** | The student is able to:<br>- require detailed knowledge in the field of biomedical technology,<br>- understand and apply various microsystems and sensors to be used in the biomedical technology sector,<br>- comprehend and use the different norms and standards for the creation of biomedical devices,<br>- learn and apply the requirements and specifications for the models and structures of the biomedical technology<br><br>Learning results with regard to the objectives of the course of study:<br>- Gaining deeper insight into the biomedical fundamentals.<br>- Acquiring enhanced and applied basics with respect to the norms and standards of the biomedical technology.<br>- Gaining a deeper knowledge about biomedical devices.<br>- Identifying and classifying complex biomedical and interdisciplinary tasks.<br>- Gaining important and profound experience in the field of practical activities regarding biomedical technology.<br>- Working and researching in national and international contexts. |
| **Types of courses** | VL+Ü, VL+P, P, S (lecture+ exercise, lecture+ project, project, seminar)<br>4 SWS (semester periods per week) |
| **Requirements for the participation in the module** | None |
| **Student workload** | 180 h |
| **Academic performances** | None |
| **Precondition for the admission to the examination performance** | Giving a seminar presentation,<br>writing a term paper,<br>participating in all presentations and dealing with a report, exercises, tests, result report, attestation, final discussion, laboratory tasks, lectures, oral examination, term paper |
| **Examination performance** | Depending on the selected module<br>90 minutes for the presentation followed by a discussion,<br>oral examination 20-40 min.,<br>written examination 60-180 min.,<br>writing a term paper and giving a presentation,<br>graded term paper |
| **Number of credits of the module** | 6 credits |

Focus module "Safety Structures for Vehicles"

| Module name | Safety Structures for Vehicles |
|---|---|
| Type of module | Focus module |
| Learning results, competencies, qualification goals | The student is able to:<br>- comprehend and apply the gained knowledge about electrical engineering in the different areas of application;<br>- acquire different, general and sector-specific norms of the functional safety as well as to apply them to practice-oriented issues;<br>- derive and analyse methods and procedures for complex electro technical and interdisciplinary tasks;<br>- derive and create requirements and specifications for a safe operation and evaluation of analytical methods according to various international standards;<br>- name the different methods that are required in order to create solving methods for complex safety-related architectures and is able to apply these techniques;<br>- experience various profound, practice-orientated and important technical and engineering procedures and methods. |
| Types of courses | VL+Ü, VL+P, P, S (lecture+ exercise, lecture+project, project, seminar)<br>4 SWS (semester periods per week) |
| Requirements for the participation in the module | None |
| Student workload | 180 h |
| Academic performances | None |
| Precondition for the admission to the examination performance | Solve a theoretical task dealing with regulations including implementation,<br>giving a seminar presentation,<br>writing a term paper,<br>participating in all presentations and dealing with a report, exercises, tests, result report, attestation, final discussion, laboratory tasks, lectures, oral examination, term paper |
| Examination performance | 90 minutes for the presentation followed by a discussion,<br>oral examination 20-40 min.,<br>written examination 60-180 min.,<br>writing a term paper and giving a presentation,<br>graded term paper |
| Number of credits of the module | 6 credits |