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Technische Universität Dresden
Faculty of Computer Science

Study Regulations for the consecutive Master's degree program Distributed Systems Engineering

as of May 18, 2020

On the basis of § 36 para.1 of the Act on the Autonomy of Institutions of Higher Education in the Free State of Saxony (*Sächsisches Hochschulfreiheitsgesetz*) in the version published on January 15, 2013 (SächsGVBl. p. 3), Technische Universität Dresden issues the following Study Regulations as statutes.

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§ 1 Scope

On the basis of the Act on the Autonomy of Institutions of Higher Education in the Free State of Saxony (SächsHSFG) and the examination regulations, these Study Regulations stipulate the objectives, content, structure and organization of the consecutive Master's program Distributed Systems Engineering at Technische Universität Dresden.

§ 2 Objectives of the degree program

(1) Graduates of the Master's degree program Distributed Systems Engineering will be able to analyze problems from the field of distributed systems and, based on this, independently develop correspondingly effective solutions. They will possess proficient fundamental knowledge of the various professional disciplines involved in the degree program and will be able to apply this knowledge in specific scenarios thanks to the application-oriented structure of the degree program. They will be proficient in the design, development and operation of distributed systems, know various middleware architectures and their possible applications, be familiar with the field of mobile communication and able to analyze distributed systems in terms of their reliability and security and potential points of attack. The flexibility of the elective compulsory field requires students to deal with the various professional disciplines and thus promotes the ability to organize projects independently, even outside of the degree program. Students will also be capable of critical self-reflection and of social commitment and will have developed their personality. Moreover, they will be able to independently familiarize themselves with new issues and problems and to develop effective solutions.

(2) Due to their broad technical knowledge as well as their familiarity with the global research community in the field of distributed systems, acquired during internationally oriented modules, graduates will be qualified to handle diverse and complex tasks in the development and operation of distributed computer systems following an appropriate training period in professional practice.

§ 3 Admission requirements

To be admitted to the degree program, candidates must have completed a first recognized vocational university degree acquired in Germany or a qualification from an officially recognized vocational academy in computer science. Moreover, they must have special expertise in the areas of operating systems, computer networks, database systems, software engineering, mathematics, distributed systems, and advanced programming skills. Proof of this particular suitability is provided by an aptitude assessment in accordance with the aptitude assessment regulations for DSE in its current version. Furthermore, knowledge of English at C1 level of the Common European Framework of Reference for Language is a prerequisite. Proof thereof is provided via a relevant certificate.

§ 4

Start and duration of the degree program

(1) The program can be started each winter semester.

(2) The standard period of study is four semesters and includes on-site attendance, independent study and the Master's examination.

§ 5

Teaching and learning methods

(1) The curriculum is structured in modules. In the individual modules, the course content is taught, consolidated and deepened through lectures, seminars, practicals, internships, vocational internships, language courses and independent study.

(2) Lectures introduce the subject matter and content of subfields of individual subject topics at the conceptual level. Practicals serve to acquire the necessary methodological and technical skills. The acquired knowledge is applied in exemplary subfields. Additionally, practicals provide students with the opportunity to discuss their solutions to training tasks in capable groups and under guidance. Seminars enable students to familiarize themselves under supervision in a selected subject area on the basis of specialist literature or other material, to report on the results of their work and to defend them, to discuss them within the group and to present them in writing. Internships are an integral part of the program and serve the individual implementation of a task in a single project or in small groups in order to apply and deepen the taught content in practice and to acquire practical skills in working with hardware and software. The vocational internship is a special form of internship that is carried out in a company in order to gain additional first practical work experience. Independent study enables students to acquire both fundamental and in-depth subject knowledge independently using various media, such as literature and eLearning, in individual work or small groups. Language courses convey and hone knowledge, skills and abilities in a foreign language. They foster the development of communication and intercultural competences in academic and professional contexts, as well as in everyday situations.

§ 6

Structure and organization of the degree program

(1) The program is organized in modules. The curriculum is divided into three semesters. The fourth semester is dedicated to writing the Master's thesis and its defense.

(2) The degree program comprises 7 compulsory modules earning 45 credit points, 7 elective compulsory modules of the expert specialization earning 42 credit points, which allow students to choose their concentration, as well as an elective compulsory module earning 3 credit points from the area of language training. The selection is binding. Modules can be re-selected; the student must submit a written request to the Examination Office stating the module to be replaced and the newly selected module. Deselected modules cannot be selected again.

(3) Learning goals, content, teaching and learning methods included, requirements, applicability, frequency, workload, and duration of the individual modules are all listed in the module descriptions (Annex 2).

(4) The courses are held in English or, if indicated by the module descriptions, in German.

(5) The appropriate allocation of the modules to the individual semesters, the observance of which makes it possible to complete the program within the standard period of study, as well as the type and scope of the respective courses included, and the number and standard period of time of the required study achievements and examined assessments are defined in the study schedule attached (Annex 1 part 1).

(6) If participation in an elective compulsory module is limited by the number of available places, the participants will be selected in the order that they registered. The form and deadline for registering as well as the number of available places will be announced to students as is customary at the faculty in due course.

(7) Upon proposal of the Academic Affairs Committee, the Faculty Board may change the range of elective compulsory modules as well as the study schedule. The current selection of elective compulsory modules available will be announced at the beginning of the semester as is customary at the faculty. The amended study schedule will apply to all students who have been informed about this as is customary at the faculty at the beginning of their studies. The Examination Committee will decide, upon application by the student, on any exceptions to sentence 3.

§ 7

Content of the degree program

(1) Distributed Systems Engineering is a research-oriented Master's degree program.

(2) In the compulsory field, the program comprises the following topics:

1. Fundamentals of distributed systems design, development, and operation,
2. Middleware architectures and platforms for building distributed applications and information systems,
3. Building distributed and secure systems from a reliability and data security perspective,
4. Fundamental methods, design elements and notations for the systematic development of large software systems using design patterns and frameworks.

(3) The range of elective compulsory modules includes modules on data security, networks and computer networks, distributed operating systems, simulation and component-based software development, Internet-based systems, software fault tolerance, real-time systems, microkernel-based systems, application development for mobile environments, principles of reliable systems, and development of embedded systems.

§ 8

Credit points

(1) ECTS credits document the average workload of the students and their individual study progress. One credit point corresponds to a 30-hour workload. Normally, 60 credit points are awarded per academic year, i.e. 30 credit points per semester. The total workload for the program corresponds to 120 credit points and comprises the teaching and learning methods according to type and scope stipulated in the module descriptions, the study achievements and examined assessments, independent study, the Master's thesis and the defense.

(2) The module descriptions indicate the number of credits that can be earned by each module. Credits are awarded upon passing the module examination. § 28 of the examination regulations shall remain unaffected.

§ 9

Academic advisory and counseling service

(1) General advice will be provided by the Central Student Information and Counseling Service at TU Dresden. It covers questions regarding study options, enrollment modalities and general student affairs. Subject-specific guidance during studies will be provided by the Academic Advisory Service of the Faculty of Computer Science. This subject-specific advisory service assists students with regard to the design of their studies.

(2) At the beginning of the third semester, each student who has not yet provided proof of academic performance must make use of the subject-specific advisory service. The Examination Office of the Faculty of Computer Science will issue a corresponding request.

(3) Students who have not started their Master's thesis within one year after the end of the standard period of study must attend an academic advisory session. The Examination Office of the Faculty of Computer Science will issue a corresponding request.

§ 10

Amendments to module descriptions

(1) In order to amend to changed conditions, module descriptions may be changed in a simplified procedure in order to optimize study organization, with the exemption of the fields "Module name", "Learning goals", "Content", "Teaching and learning methods", "Requirements for earning credit points", "Credit points and grades" and "Module duration".

(2) In a simplified procedure, the Faculty Board will adopt the amendments to the module descriptions upon proposal of the Academic Affairs Committee. The amendments shall be published as is customary at the faculty.

§ 11

Entry into force, publication and interim arrangements

(1) These Study Regulations shall enter into force on the day following their publication in the Official Announcements of TU Dresden.

(2) They apply to all students enrolled in the Master's program in Distributed Systems Engineering in the 2020/2021 winter semester or later.

(3) For students who enrolled earlier than in the 2020/2021 winter semester, the Study Regulations for the Master's degree program Distributed Systems Engineering that has been valid for them up until the amendment continues to apply unless the Examination Committee approves their transfer. Students must submit a corresponding request; the Examination Committee will determine the form and deadline of the declaration as is customary at the faculty. Switching to the

new regulations is possible at the earliest on October 1, 2020. The transfer will be approved if less than 90 credit points have been earned after deducting the credit points earned for the Master's thesis and its defense. However, a transfer will not be approved if any module of the compulsory field has been irrevocably failed.

(4) These Study Regulations will apply from the 2022/2023 winter semester for all students enrolled in the Distributed Systems Engineering Master's degree program who up to that date have earned less than 90 credit points after deduction of the credit points earned for the Master's thesis and its defense.

(5) In the case of transfer according to para. 3 clause 1 or para. 4, primarily the module examinations already taken including the grades, and subordinately also individual examination achievements will be transferred ex officio on the basis of equivalence tables which have been determined by the Examination Committee and announced open to the faculty. With the exception of § 16 para. 5 of the examination regulations, module examinations and examined assessments not graded with at least "pass" (4.0) or "passed" will not be transferred. The module grade is generally not recalculated based on exclusively transferred examined assessments; exceptions are listed in the equivalence tables.

Issued based on the resolution of the Faculty Board of the Faculty of Computer Science as of July 24, 2019, and the approval of the University Executive Board as of October 22, 2019.

Dresden, May 18, 2020

The Rector
of Technische Universität Dresden

Prof. Dr.-Ing. habil. DEng/Auckland Hans Müller-Steinhagen

Annex 1, Part 1: Study schedule

including type and scope of the courses in hours per week (SWS) as well as required academic work, the type, scope and design of which can be found in the module descriptions

Module no.	Module name	1 st semester	2 nd semester	3 rd semester (M)	4 th semester	Credits	Σ	
		V/Ü/S/P	V/Ü/S/P	V/Ü/S/P	V/Ü/S/P			
Compulsory modules								
INF-DSE-20-M-SE1	Foundations of Systems Engineering	2/2/0/0, PVL, PL				5	45	
INF-DSE-20-M-SE2	Advanced Concepts of Systems Engineering	2/2/0/0, PVL, PL				5		
INF-DSE-20-M-DSMC	Ubiquitous Systems	4/2/0/0, PL				7		
INF-DSE-20-M-TIS	Transactional Information Systems	2/2/0/0, PL				5		
INF-DSE-20-M-SEC	Foundations of Security and Cryptography	2/2/0/0, PL				5		
INF-DSE-20-M-DPF	System Design	2/2/0/0, PL				5		
INF-DSE-20-M-INT	Internship		360h BP, PL+BV or 8 SWS P, PL ^{A)}			13		
Elective compulsory modules								
Elective compulsory modules of the professional specialization (<i>in the scope of 42 credit points</i>)								
INF-DSE-20-E-xx	Modules pursuant to Annex 1, Part 2		28 V/Ü/S/P ^{B)}			each 3 / 6	45	
Elective compulsory modules of the language training (<i>in the scope of 3 LP</i>)								
INF-DSE-20-LN-DE	German Language Skills		4 SK, PL ^{C)}			3		
INF-DSE-20-LN-EN	English – Advanced Professionals		2 SK, PL ^{D)}			3		
					Master's thesis Thesis defense	29 1	30	
Credits		32	28	30	30	120	120	

^{A)} Type and scope of the examined assessments vary depending on the student's choice according to the INF-INF-DSE-20-M-INT course catalogue.

^{B)} Type and scope of the individual teaching and learning methods as well as the number of examined assessments vary depending on the student's choice according to Annex 1, Part 2.

^{C)} Type and scope of the individual teaching and learning methods as well as the number of examined assessments vary depending on the student's choice according to the INF-INF-DSE-20-LN-DE course catalogue.

^{D)} Type and scope of the individual teaching and learning methods as well as the number of examined assessments vary depending on the student's choice according to the NF-INF-DSE-20-LN-EN course catalogue.

Explanation:

V = lecture (Vorlesung) Ü = practical (Übung) S = seminar (Seminar) P = internship (Praktikum) BP = vocational internship (Berufspraktikum)
SK = language courses (Sprachkurse)
PVL = preliminary academic work (Prüfungsvorleistung) PL = examined assessment (Prüfungsleistung) BV = further requirement for passing (weitere Bestehensvoraussetzung)

Annex 1, Part 2: Modules of the professional specialization

including type and scope of the courses in hours per week (SWS) as well as required academic work, the type, scope and design of which can be found in the module descriptions

Module no.	Module name	2 nd semester	3 rd semester (M)	Credits
		V/Ü/S/P	V/Ü/S/P	
INF-DSE-20-E-ASC	Advanced Security and Cryptography	2/2/0/0, PL		6
INF-DSE-20-E-WSN	Wireless Sensor Networks	2/2/0/0, PVL, PL		6
INF-DSE-20-E-ASICS	Academic Skills in Computer Science	2/2/0/0, PL		6
INF-DSE-20-E-DOS	Distributed Operating Systems	4 V/Ü/S/P, PL ¹⁾		6
INF-DSE-20-E-OSS	Operating Systems Security		4 V/Ü/S/P, PL ²⁾	6
INF-DSE-20-E-RTS	Real Time Systems		4 V/Ü/S/P, PL ³⁾	6
INF-DSE-20-E-SOS	Special Operating Systems	4 V/Ü/S/P, PL ⁴⁾		6
INF-DSE-20-E-CBSE	Component-Based Software Engineering	2/2/0/0, PL		6
INF-DSE-20-E-IWA	Internet and Web Applications	2/2/0/0, PL		6
INF-DSE-20-E-PET	Prediction and Estimation Techniques		2/2/0/0, PL	6
INF-DSE-20-E-EAMA	Engineering Adaptive Mobile Applications		2/2/0/0, PVL, PL	6
INF-DSE-20-E-FCDS	Foundations of Concurrent and Distributed Systems	4/0/0/0, PL		6
INF-DSE-20-E-FCDS-L	Lab: Concurrent and Distributed Systems	0/0/0/4, PL		6
INF-DSE-20-E-SFT	Foundations of Software Fault Tolerance	2/2/0/0, PL		6
INF-DSE-20-E-SFT-L	Lab: Software Fault Tolerance		0/0/0/4, PL	6
INF-DSE-20-E-PODS	Principles of Dependable Systems		2/2/0/0, PVL, PL	6
INF-DSE-20-E-SEM	Current Topics in Systems Engineering		0/0/2/0, PL	3
INF-DSE-20-E-RLS	Robolab Sessions		0/0/0/4, PVL, PL	6
INF-DSE-20-E-EHS	Embedded Hardware Systems Design	2/2/0/0, PL		6
INF-DSE-20-E-EHS-L	Lab: Embedded Hardware Systems		0/0/0/4, PL	6
INF-DSE-20-E-EMA	Design and Programming of Embedded Multicore Architectures	2/2/0/0, PL		6
INF-DSE-20-E-HMS	Hardware Modelling and Simulation		2/2/0/0, PL	6
INF-DSE-20-E-MKS	Micro-Kernel-based Systems		4 V/Ü/S/P, PL ⁵⁾	6
INF-DSE-20-E-ADSE	Across the Disciplines of Distributed Systems Engineering	4 V/Ü/S/P, PL ⁶⁾		6
INF-DSE-20-E-BDSE	Beyond Distributed Systems Engineering		2 V/Ü/S/P, PL ⁷⁾	3

¹⁻⁷⁾ Type and scope of the individual teaching and learning methods as well as the number of examined assessments vary depending on the student's choice according to the course catalogues ¹⁾ INF-INF-DSE-20-E-DOS,

²⁾ INF-INF-DSE-20-E-OSS, ³⁾ INF-INF-DSE-20-E-RTS, ⁴⁾ INF-INF-DSE-20-E-SOS, ⁵⁾ INF-INF-DSE-20-E-MKS, ⁶⁾ INF-INF-DSE-20-E-ADSE, ⁷⁾ INF-INF-DSE-20-E-BDSE

Annex 2: Module descriptions

Module number	Module name	Module coordinator
INF-DSE-20-M-SE1	Foundations of Systems Engineering	Prof. Fetzer se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of this module, participants will be able to design distributed software platforms using modern hardware and software components. Participants will understand what challenges distributed systems present in terms of programming and correct execution, and will be able to evaluate them and apply appropriate mechanisms.	
Content	The module covers the design, building, and operation of software platforms. This module focuses on current topics in the architecture of distributed systems. These include parallel computing on current hardware, ensuring composability and security of complex modules, testing methods to identify errors as quickly as possible, and managing human resources dedicated to supporting collaboration.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the fundamentals of operating systems, computer architecture, and computer networks at Bachelor's level.	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program. It fulfills the requirements for the modules Internship, Foundations of Concurrent and Distributed Systems, Foundations of Software Fault Tolerance, Principles of Dependable Systems, Current Topics in Systems Engineering as well as Across the Disciplines of Distributed Systems Engineering.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 60-minute written test. As preliminary academic work, a collection of exercises totaling 30 hours must be completed.	
Credit points and grades	The module is worth 5 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 150 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-M-SE2	Advanced Concepts of Systems Engineering	Prof. Fetzner se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of this module, participants will be able to design highly scalable as well as distributed systems that can be operated in cloud environments. The participants will be familiar with approaches, principles and specific implementations regarding the correct operation of distributed applications.	
Content	The module covers specific examples of some services with large distributed systems that enable cloud computing. The focus is on the architecture, building and operation of scalable systems.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the fundamentals of operating systems, computer architecture, and computer networks at Bachelor's level.	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program. It fulfills the requirements for the modules Internship, Foundations of Concurrent and Distributed Systems, Foundations of Software Fault Tolerance, Principles of Dependable Systems, Current Topics in Systems Engineering as well as Across the Disciplines of Distributed Systems Engineering.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 60-minute written test. As preliminary academic work, a collection of exercises totaling 30 hours must be completed.	
Credit points and grades	The module is worth 5 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 150 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-M-DSMC	Ubiquitous Systems	Prof. Schill rechnetworke@tu-dresden.de
Learning goals	The participants will be familiar with the design, structure and requirements of distributed applications and mobile communication networks. They will have gained insight into the challenges of distributed applications in mobile networks and will be able to analyze and evaluate distributed applications for both static and mobile environments, as well as independently develop these systems and put them into practice. Participants will also have a basic understanding of how to break down large monolithic applications into their component parts in order to design scalable, distributed systems. They will be sensitized to the problems of distributed applications that arise, especially in mobile networks, and will be able to avoid them even when applied to unknown use cases.	
Content	The module covers the problems, concepts and solution approaches for developing distributed systems. The focus is on elementary fundamental principles and basic techniques as well as current standards. Moreover, the module addresses the fundamentals of mobile communication and its applications in the field of mobile computing. In addition to basics of transmission of radio networks, typical standards and network concepts, the module covers software architectures for mobile computing and distributed systems in the field of application support. The module also includes an outlook on future high-performance mobile networks and their applications.	
Teaching and learning methods	The module comprises lectures amounting to 4 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the fields of computer networks, Java, and database systems at Bachelor's level.	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program. It fulfills the requirements for the modules Internship, Engineering Adaptive Mobile Applications as well as Across the Disciplines of Distributed Systems Engineering.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 120-minute written test.	
Credit points and grades	The module is worth 7 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 210 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-M-TIS	Transactional Information Systems	Prof. Lehner wolfgang.lehner@tu-dresden.de
Learning goals	Students will be able to clearly structure a section of the real world using entity-relationship data modelling in the sense of personal and social competence and relational data modelling as well as design theory (methodological competence). Moreover, students will be able to correctly classify and understand selected system-oriented aspects in the implementation of database systems (technical competence). The main focus is on query optimization and the transaction concept. Students will also have an understanding of how database development as an elementary component embeds into an overarching software development process (overarching action competence).	
Content	The module covers the fundamentals of the scientific field of databases, including theoretical knowledge such as the entity-relationship model, the relational model and database design theory with relational algebra. In addition, the module also contains the most essential aspects of the implementation of database systems. This includes in particular synchronization in distributed and non-distributed scenarios, restart and error handling, index structures, and query processing and optimization. Moreover, the module covers the practical use of the descriptive query language SQL.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the fundamentals of operating systems, computer architecture, and software engineering at Bachelor's level.	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program. It fulfills the requirements for the modules Internship as well as Across the Disciplines of Distributed Systems Engineering.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 90-minute written test.	
Credit points and grades	The module is worth 5 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 150 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-M-SEC	Foundations of Security and Cryptography	Chair of Privacy and Data Security dud-lehre@tu-dresden.de
Learning goals	After successful completion of this module, the participants will have basic skills to perform a requirements analysis from a security perspective, i.e., they will be able to identify protection goals to be implemented and perform attacker modeling. They will be able to evaluate a basic security concept with regard to the protection goals of confidentiality and integrity and to create one themselves. They understand the basic mechanisms of symmetric and asymmetric cryptographic algorithms.	
Content	The content of the module includes the fundamentals of data security: potential security risks and attack scenarios, an overview of service-based security including protection goals, and the topics of cryptography and access control.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have fundamental knowledge and skills in data privacy and data security at Bachelor's level.	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program. It fulfills the requirements for the modules Internship, Across the Disciplines of Distributed Systems Engineering, and Advanced Security and Cryptography.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 90-minute written test.	
Credit points and grades	The module is worth 5 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 150 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-M-DPF	System Design	Prof. Aßmann softwaretechnologie@tu-dresden.de
Learning goals	Upon successful completion of the module, students will master the basic methods, design elements, and notations for systematic modeling, design and development of large object-oriented software systems with a particular focus on the aspect of reuse of classes and frameworks. Graduates of the module will master the use of design patterns and their foundation, role modeling. They will be able to participate in the design and development of large software systems according to the consolidated state of the art and apply them in practical scenarios.	
Content	The module includes design patterns as a technique that enables the reuse of a design idea without the need to reuse the code, as is common with software components. The module includes design patterns in UML and programming languages for variability, extensibility, and the combination of components. In addition to the classic patterns from the book of the so-called "Gang of Four" (Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides), the module covers advanced patterns from existing literature, as well as object-oriented role modeling.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Basic and practical knowledge of the following techniques at Bachelor's level is required: Principle of object orientation, programming in Java, C#, Python, or C++, UML modelling (class diagrams, object diagrams, state diagrams, sequence diagrams).	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program. It fulfills the requirements for the modules Internship as well as Across the Disciplines of Distributed Systems Engineering.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a project work with a scope of 60 hours.	
Credit points and grades	The module is worth 5 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 150 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-M-INT	Internship	Studies Coordinator dse-info@mailbox.tu-dresden.de
Learning goals	Upon successful completion of this module, participants will be able to independently implement individual projects with a focus on the practical application of the knowledge of distributed systems acquired during their studies. They will be enabled to analyze complex problems and develop efficient approaches to solving them. They will thus be able to understand and discuss future practical scenarios encountered in their professional activities and to find applicable solutions. In addition, they may have initial work experience with an international focus and advanced foreign language skills.	
Content	The module covers practical knowledge in the field of software engineering of distributed systems. Depending on the participants' choice, the module content may also include initial vocational experience, the use of versioning and ticketing systems, and other project management applications.	
Teaching and learning methods	The module consists optionally of a vocational internship in a company amounting to 360 hours or internships amounting to a total of 8 SWS from the INF-DSE-20-M-INT course catalogue as well as independent study. The INF-DSE-20-M-INT course catalogue including the respective required examined assessments is announced at the beginning of the semester as is customary at the faculty.	
Prerequisites	The knowledge and skills acquired in the following modules are required: Foundations of Systems Engineering, Advanced Concepts of Systems Engineering, Ubiquitous Systems, Transactional Information Systems, Foundations of Security and Cryptography, and System Design.	
Applicability	This module is a compulsory module in the Distributed Systems Engineering Master's degree program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination and completing the further requirement for passing, if any. If a vocational internship is chosen, the module examination consists of an ungraded internship report of 30 hours. A further requirement for passing the module according to § 15 para. 1 sentence 4 Examination Regulations is the completion of a vocational internship. There is an obligation to provide evidence in accordance with § 15 para. 1 sentence 5 Examination Regulations. If participants opt for internships, the module examination consists of the examined assessment specified in the INF-DSE-20-M-INT course catalog.	
Credit points and grades	The module is worth 13 credit points. There is no grade for the module.	
Frequency of the	The module can be taken at any time and is not bound by the rigid	

module	time constraints of semester dates. Internships spanning more than one semester are explicitly encouraged within the scope of the specified workload.
Workload	The workload comprises 390 hours.
Module duration	The module lasts for one semester.

Module number	Module name	Module coordinator
INF-DSE-20-E-ASICS	Academic Skills in Computer Science	Prof. Aßmann softwaretechnologie@tu-dresden.de
Learning goals	Upon successful completion of this module, students will be able to plan and write academic papers such as their Master's thesis or research papers. They will know what types of research papers they can write, what research hypotheses there are, and how to develop an outline for a paper. The practical exercises will also enable them to independently develop and present scientific papers based on their sound fundamental knowledge.	
Content	The module covers the foundations of academic writing. This includes methods for solving problems and generating ideas, formulating research hypotheses and validating them, knowing the various outline schemes for papers, argumentations and presentations, and ensuring coherence and cohesion in writing.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites		
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a project work with a scope of 90 hours.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-CBSE	Component-Based Software Engineering	Prof. Aßmann softwaretechnologie@tu-dresden.de
Learning goals	Upon successful completion of the module, students will be able to address challenges of modern complex software systems using a component-based development approach. They will understand how to build applications step by step using independent components and to increase their flexibility. The practical exercises will enable them to solve realistic problems and, drawing on their sound fundamental knowledge, to handle new requirements as they arise.	
Content	The module covers knowledge of composition systems and their essential components: component models, composition techniques, and composition languages. Metamodelling and metaprogramming are used to model component models. Building on these foundations, students will be able to contrast classic component models such as Enterprise JavaBeans or Web services with modern, invasive component models such as aspect-oriented development or generic programming.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Basic and practical knowledge of the following techniques at Bachelor's level is required: Principle of object orientation, programming in Java, C#, Python, or C++, UML modeling (class diagrams, object diagrams, state diagrams, sequence diagrams).	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a project work with a scope of 90 hours.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-FCDS	Foundations of Concurrent and Distributed Systems	Prof. Fetzter se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to analyze applications that run on parallel and distributed systems as well as make efficient and complete use of their computational capacities. Participants will understand how data inconsistencies can arise due to concurrency. Moreover, upon completion of the module, participants will be able to apply appropriate principles that increase concurrency and the related performance, while guaranteeing data consistency.	
Content	The module covers how the computing power of modern CPUs and their cores can be used simultaneously/parallel and thus efficiently. This includes in particular the fundamentals of parallel and distributed systems, which are required for the development of parallel and distributed applications on such processors. In addition to theoretical fundamentals, the course covers basic aspects of the development of parallel high-performance programs.	
Teaching and learning methods	The module comprises lectures amounting to 4 SWS as well as independent study.	
Prerequisites	The knowledge and skills acquired in the following modules are required: Foundations of Systems Engineering, and Advanced Concepts of Systems Engineering.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program. It fulfills the requirements for the module Lab: Concurrent and Distributed Systems.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 30-minute oral examination.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-FCDS-L	Lab: Concurrent and Distributed Systems	Prof. Fetzter se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to develop and implement applications that run on parallel and distributed multi-core architectures and make efficient and complete use of their computational capacities. The participants will be able to identify sources of errors regarding concurrency and to correct them. Moreover, upon completion of the module, participants will be able to evaluate and optimize the performance of parallel-running applications.	
Content	The module covers practical knowledge of programming multi-core CPUs/architectures so that parallel/concurrent applications can efficiently utilize the processing power of the underlying processor. This includes practical fundamentals for the development and optimization of parallel-running, resource-efficient high-performance programs.	
Teaching and learning methods	The module comprises an internship with the scope of 4 SWS as well as independent study.	
Prerequisites	Students already need to be familiar with the knowledge and skills acquired in the module Foundations of Concurrent and Distributed Systems.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises ungraded project work with a scope of 90 hours.	
Credit points and grades	The module is worth 6 credit points. There is no grade for the module.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-PODS	Principles of Dependable Systems	Prof. Fetzner se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to develop and implement secure and fault-tolerant software systems. The participants will understand the interaction between software and hardware components and will be able to analyze and evaluate their behavior with regard to correctness.	
Content	The module covers design principles for developing highly reliable systems, i.e. systems that are available as well as reliable and secure. This includes an overview of the hardware architectures, their coupling with various software components as well as fault tolerance mechanisms and their applications of the different levels.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	The knowledge and skills acquired in the following modules are required: Foundations of Systems Engineering, and Advanced Concepts of Systems Engineering.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 60-minute written test. As preliminary academic work, a collection of exercises totaling 30 hours must be completed.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-RLS	Robolab Sessions	Prof. Fetzter se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, students will be able to practically apply real-world problems and basic algorithms of automata theory and coding theory in the context of programming robots and transfer them to hardware. Moreover, students will have expanded their programming skills and gained experience in independent project or team work.	
Content	The module covers basic algorithms of automata theory and coding theory as well as the coding of robots programming close to the hardware, e.g. on a LEGO Mindstorms EV3 robot or another microcontroller.	
Teaching and learning methods	The module comprises an internship with the scope of 4 SWS as well as independent study.	
Prerequisites	Students must have fundamental knowledge and skills in classical problems in computer science as well as programming skills at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a project work with a scope of 60 hours. As preliminary academic work, a collection of exercises totaling 30 hours must be completed.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-SEM	Current Topics in Systems Engineering	Prof. Fetzter se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to comment on current developments in the field, to evaluate them, and to independently search for, find, and evaluate relevant literature on the subject. They will also have the ability to understand scientific articles, process their contents, and present them.	
Content	The course content is offered every semester depending on current developments in the fields of "Software Fault Tolerance" and "Dependable Systems".	
Teaching and learning methods	The module comprises a seminar with the scope of 2 SWS as well as independent study. The course in the required scope is to be chosen from the INF-DSE-20-E-SEM course catalogue; it will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	The knowledge and skills acquired in the following modules are required: Foundations of Systems Engineering and Advanced Concepts of Systems Engineering, as well as, depending on the student's thematic choice: Foundations of Software Fault Tolerance.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a presentation with a scope of 45 hours.	
Credit points and grades	The module is worth 3 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each semester.	
Workload	The workload comprises 90 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-SFT	Foundations of Software Fault Tolerance	Prof. Fetzner se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to develop fault-tolerant software systems so that their probability of failure is minimized and their security is increased. The participants know the different failure types and classes and can analyze and evaluate their probability of failure. Moreover, the participants will be able to apply different principles regarding robustness in order to minimize the systems' probability of failure.	
Content	The module covers theoretical foundations of various fault-tolerant mechanisms and analysis methods, which can be applied statically or dynamically. Moreover, the module includes mechanisms that increase the robustness of distributed systems. In addition to reliability, the module also covers aspects such as the security of such systems against cyber attacks.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	The knowledge and skills acquired in the following modules are required: Foundations of Systems Engineering, and Advanced Concepts of Systems Engineering.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program. It fulfills the requirements for the modules Current Topics in Systems Engineering and Lab: Software Fault Tolerance.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 30-minute oral examination.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-SFT-L	Lab: Software Fault Tolerance	Prof. Fetzter se@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to minimize the error proneness of software systems. Participants will be able to analyze existing systems and evaluate their error rate as well as to reduce it by using various mechanisms.	
Content	The module covers the practical application of various fault-tolerant mechanisms and analysis methods, which can be applied statically or dynamically. This includes in particular the development and optimization of fault-tolerant, reliable software.	
Teaching and learning methods	The module comprises an internship with the scope of 4 SWS as well as independent study.	
Prerequisites	Students already need to be familiar with the knowledge and skills acquired in the module Foundations of Software Fault Tolerance.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises ungraded project work with a scope of 90 hours.	
Credit points and grades	The module is worth 6 credit points. There is no grade for the module.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-EMA	Design and Programming of Embedded Multicore Architectures	Prof. Göhringer ads@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have qualified knowledge in the areas of design and programming of modern embedded systems and in the area of simulation of embedded multicore architectures. They will also possess practical skills for using embedded operating systems, such as Embedded Linux or FreeRTOS, on a modern embedded system, such as a Xilinx Zynq System-on-Chip.	
Content	The module covers overview and expert knowledge in the areas of design, simulation, and programming of modern embedded systems consisting of multiple processors and special accelerators.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have fundamental knowledge and skills in computer architecture at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of an oral examination of 20 minutes duration for up to 10 registered participants. If there are more than 10 participants, it consists of a 60-minute written examination. The module coordinator will announce the type of the specific examined assessment at the end of the examination enrollment period as is customary at the faculty.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-HMS	Hardware Modelling and Simulation	Prof. Göhringer ads@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be qualified in the areas of simulation, evaluation and verification of digital systems, such as field programmable gate arrays (FPGAs) and in the area of modelling of digital systems using SystemC. They will also have practical skills in programming digital systems using the hardware description language VHDL and experience from example projects.	
Content	The module covers overview and expert knowledge in the areas of simulation, evaluation and verification of digital systems for programming digital systems using the hardware description language VHDL and the modelling language SystemC.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students require programming skills in C/C++ as well as fundamental knowledge and skills in technical computer science at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of an oral examination of 20 minutes duration for up to 10 registered participants. If there are more than 10 participants, it shall consist of a 60-minute written examination. The module coordinator will announce the type of the specific examined assessment at the end of the examination enrollment period as is customary at the faculty.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-EHS	Embedded Hardware Systems Design	Prof. Kumar akash.kumar@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have the theoretical foundations to translate system specifications into executable computational models using a high-level specification language and to decode these formal specifications into a register transfer level HDL that can be implemented on an FPGA.	
Content	The module covers the theoretical foundations for developing complex embedded systems. This includes selected methodologies for embedded systems development, the foundations of specifying and modelling systems, architectures of embedded systems, and theoretical foundations of decoding specifications into architectures.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have fundamental knowledge in the field of computer architecture and embedded systems. Moreover, knowledge in hardware design, e.g. VHDL and FPGA, is an advantage.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program. It fulfills the requirements for the module Lab: Embedded Hardware Systems.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 30-minute oral examination.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-EHS-L	Lab: Embedded Hardware Systems	Prof. Kumar akash.kumar@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to directly translate system specifications into executable computational models using a high level specification language and decode these formal specifications into a register transfer level HDL.	
Content	The module covers the practical development of complex embedded systems. This includes the application of embedded systems development methodologies, the actual specification and modelling of selected problems, the practical decoding of specifications in architectures, and the rapid construction of a prototype on FPGA platforms.	
Teaching and learning methods	The module comprises an internship with the scope of 4 SWS as well as independent study.	
Prerequisites	Students already need to be familiar with the knowledge and skills acquired in the module Embedded Hardware Systems Design.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a project work with a scope of 90 hours.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-EAMA	Engineering Adaptive Mobile Applications	Prof. Schill rechnernetze@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be familiar with the challenges of context-sensitive applications for mobile, ubiquitous systems as well as adaptation mechanisms for such applications. Moreover, they will be able to independently apply and transfer this knowledge as they will be enabled to design and implement adaptive applications for mobile and ubiquitous systems, as well as to evaluate and improve existing systems.	
Content	The module covers the fundamental challenges of mobile, ubiquitous applications, including issues such as context sensitivity and platform independence. Moreover, the module includes solution concepts and technologies for the development of applications for mobile and ubiquitous infrastructures.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge of the fundamentals of computer networks (Bachelor's level) and distributed systems (corresponding to the Ubiquitous Systems module) as well as fundamental knowledge of operating systems and database (management) systems at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 30-minute oral examination. As a prerequisite for the examination, students must complete and present exercises totaling 60 hours.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-IWA	Internet and Web Applications	Prof. Schill rechnernetze@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be familiar with the current state of the art in the field of Internet services and web applications, including the technologies underlying these systems. They will be able to analyze or reconstruct Internet services and web applications with regard to their technological composition and independently design rough concepts for such software systems.	
Content	The module covers principles and modes of operation of widely used and current application layer technologies on the Internet. This includes fundamental foundations of used protocols and interaction mechanisms in the World Wide Web and their most common applications. Moreover, the module covers systems beyond the World Wide Web, such as file sharing applications or content distribution networks, and multimedia communication concepts such as Internet telephony and chat systems.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the fundamentals of computer networks and distributed systems at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 90-minute written test.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-PET	Prediction and Estimation Techniques	Dr. Dargie waltenegus.dargie@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be familiar with probabilistic prediction and estimation techniques. They will be able to apply and evaluate them in the context of distributed dynamic adaptive systems.	
Content	The module covers the foundations of probabilistic prediction and estimation techniques, including the introduction and combination of random variables, the minimization of uncertainty, and the concept of minimum mean square estimation.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the mathematical foundations of stochastics and probability theory as well as fundamentals of computer networks, each at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of an oral examination of 25 minutes duration if there are less than 15 participants, and of a written examination of 90 minutes duration if there are 15 participants or more. The module coordinator will announce the type of the specific examined assessment at the end of the examination enrollment period as is customary at the faculty.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-WSN	Wireless Sensor Networks	Dr. Dargie waltenegus.dargie@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have a qualified understanding of wireless sensors, the networks built with them, their architecture, protocols, and common applications. They will be able to evaluate existing networks and build new ones.	
Content	The module covers self-organization algorithms, media access methods, routing algorithms, localization techniques, and data retention mechanisms for wireless sensor networks.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students must have knowledge and skills in the fundamentals of computer networks, including media access methods, protocols, and algorithms at Bachelor's level.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 60-minute written test. As preliminary academic work, a collection of exercises totaling 30 hours must be completed.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-DOS	Distributed Operating Systems	Chair of Operating Systems os@os.inf.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have knowledge and skills in advanced aspects of operating system design and associated functional and non-functional properties. They can use these skills in advanced work such as Master's theses or internships, for example.	
Content	The module covers advanced aspects of operating system design. This includes functional and non-functional properties from complex thematic fields such as scalability, portability, authentication, security and modeling.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 3 to 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-DOS course catalogue. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	Students must have knowledge and skills in the field of operating systems at Bachelor's level. Students can prepare themselves for the course by reading the book "Modern Operating Systems" by Andrew S. Tanenbaum.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the course catalogue.	
Credit points and grades	The module is worth 6 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module runs for the duration of one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-MKS	Micro-Kernel-based Systems	Chair of Operating Systems os@os.inf.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have a solid understanding of the design of systems based on micro-kernels and their use in critical environments (e.g. real-time, security). Participants will be able to identify and evaluate different forms of system design and have knowledge of how core functionality of a classical operating system is represented in a microkernel-based system.	
Content	The module covers in detail the design of micro-kernel-based systems. It includes both knowledge of the design of micro-kernels themselves and, based on this, knowledge of the design of systems based on micro-kernels. The module is largely based on systems of the L4 micro-kernel family.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 3 to 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-MKS course catalogue. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	Students must have knowledge and skills in the field of operating systems at Bachelor's level. Students can prepare themselves for the course by reading the book "Modern Operating Systems" by Andrew S. Tanenbaum.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the course catalogue.	
Credit points and grades	The module is worth 6 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module runs for the duration of one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-OSS	Operating Systems Security	Chair of Operating Systems os@os.inf.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have the knowledge and skills to assess system architectures regarding their security properties and to both plan and design important parts of them themselves. This knowledge includes concepts of ensuring isolation and connecting system security to cryptographic methods.	
Content	The module covers principles for designing secure systems. This includes primitives to ensure isolation at the hardware and software levels, mechanisms for defining access rights (capabilities and ACLs), and the incorporation of cryptographic and formal methods into system design.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 3 to 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-OSS course catalogue. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	Students must have knowledge and skills in the field of operating systems at Bachelor's level. Students can prepare themselves for the course by reading the book "Modern Operating Systems" by Andrew S. Tanenbaum.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the course catalogue.	
Credit points and grades	The module is worth 6 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module runs for the duration of one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-RTS	Real Time Systems	Chair of Operating Systems os@os.inf.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have the ability to use mathematical modelling to evaluate systems at multiple levels in terms of their real-time capabilities. Moreover, the participants will be able to design such systems independently according to the design paradigms discussed.	
Content	The module covers the issues of real-time systems, i.e. systems that must also be capable with regard to specified time constraints. This includes the sub-areas of task models, resource scheduling and resource management, as well as the mathematical modelling and verification of measured values in the chronological system flow. Moreover, the module comprises aspects of real-time systems in the fields of operating systems, programming languages, communication, and hardware.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 3 to 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-RTS course catalogue. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	Students must have knowledge and skills in the field of operating systems at Bachelor's level. Students can prepare themselves for the course by reading the book "Modern Operating Systems" by Andrew S. Tanenbaum.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the course catalogue.	
Credit points and grades	The module is worth 6 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module runs for the duration of one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-SOS	Special Operating Systems	Chair of Operating Systems os@os.inf.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will have a basic knowledge of the structure and functionality of the operating systems covered. They will have detailed knowledge of the solutions that the operating system in question applies to selected issues in operating system design. Moreover, based on their knowledge of the operating system in question, participants will be able to use it in application contexts or extend it with their own components.	
Content	The module covers in detail selected operating systems. It encompasses both the basic concepts of the relevant system and specific solutions that this operating system applies to general operating system design problems.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 3 to 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-SOS course catalogue. The catalogue, including the required examined assessments, will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	Students must have knowledge and skills in the field of operating systems at Bachelor's level. Students can prepare themselves for the course by reading the book "Modern Operating Systems" by Andrew S. Tanenbaum.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the course catalogue.	
Credit points and grades	The module is worth 6 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module runs for the duration of one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-ASC	Advanced Security and Cryptography	Chair of Privacy and Data Security dud-lehre@tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to independently assess the security and robustness of distributed systems. They will be familiar with the basic methods for security analysis and securing distributed systems. Moreover, they will be able to design and apply distributed systems to implement protection goals. They will also be able to acquire new knowledge on the topics of network security, security of distributed systems and security through distributed systems from scientific literature and to analyze these systems for vulnerabilities and assess them with regard to their security properties.	
Content	This module covers the basics of secure networks and distributed systems, as well as an overview of current threats and protective measures. In addition to the security of distributed systems themselves, this also includes the use of distributed systems to implement protection goals. The module includes security analysis methodologies, analysis of attacks on a network and the distributed applications therein, as well as current countermeasures. The attack scenarios include attacks on the content and the resulting meta data, as well as attacks on the services themselves (Denial of Service). The countermeasures include both proactive and reactive mechanisms. Furthermore, the module comprises mechanisms for unobservable communication and basic principles of anonymity and pseudonymity.	
Teaching and learning methods	The module comprises lectures amounting to 2 SWS and practicals amounting to 2 SWS as well as independent study.	
Prerequisites	Students already need to be familiar with the fundamental issues of data security as taught in the Foundations of Security and Cryptography module.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination comprises a 30-minute oral examination.	
Credit points and grades	The module is worth 6 credit points. The module grade corresponds to the grade of the examined assessment.	
Frequency of the module	The module is offered each year in the summer semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-ADSE	Across the Disciplines of Distributed Systems Engineering	Studies Coordinator dse-info@mailbox.tu-dresden.de
Learning goals	Upon completion of the module, participants will have acquired technical, methodological, practical and interdisciplinary skills and will have the initial skills to work on a scientific topic of system architecture of their own choice in a research-oriented manner and to identify and solve problems in a team, if required.	
Content	The module covers the participants' independent exploration of current and advanced content regarding topics that are related to the degree program, including operating systems, databases, computer networks, distributed systems and applications, data security, adaptive systems, and system architecture.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-ADSE course catalogue. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	The knowledge and skills acquired in the following modules are required: Foundations of Systems Engineering, Advanced Concepts of Systems Engineering, Ubiquitous Systems, Transactional Information Systems, Foundations of Security and Cryptography, and System Design.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program. It fulfills the requirements for the module Beyond Distributed Systems Engineering.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the INF-DSE-20-E-ADSE course catalogue.	
Credit points and grades	The module is worth 6 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each semester.	
Workload	The workload comprises 180 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-E-BDSE	Beyond Distributed Systems Engineering	Studies Coordinator dse-info@mailbox.tu-dresden.de
Learning goals	Upon completion of the module, participants will be able to apply the already acquired skills in the program to a subject beyond their own discipline or to an interdisciplinary topic (at their own choice) and to apply solution concepts in an interdisciplinary way and independent of the domain.	
Content	The module covers the participants' independent exploration of current and advanced contents regarding interdisciplinary or non-disciplinary topics. The module includes artificial intelligence, machine learning, multimedia technology, compiler construction, or medical informatics, depending on the participants' choice.	
Teaching and learning methods	The module consists of lectures, practicals, internships and seminars in the scope of 2 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-E-BDSE course catalogue. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	Students already need to be familiar with the knowledge and skills acquired in the module Across the Disciplines of Distributed Systems Engineering.	
Applicability	The module is an elective compulsory module of the professional specialization in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination consists of the examined assessments specified in the INF-DSE-20-BDSE course catalogue.	
Credit points and grades	The module is worth 3 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each semester.	
Workload	The workload comprises 90 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-LN-DE	German Language Skills	Studies Coordinator dse-info@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be proficient in German at level A1/A2 of the Common European Framework of Reference for Languages (CEFR).	
Content	The module covers basic knowledge of phonetics, orthography, grammar and syntax of the German language, training of listening, reading, speaking and writing skills, support in reflecting on aspects of German culture in everyday situations in Germany, Dresden and at the university. Moreover, the module teaches how to communicate in important everyday situations using simple language- especially in the university environment.	
Teaching and learning methods	The module comprises language courses amounting to 4 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-LN-DE course catalogue of the Faculty of Computer Science. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites	None.	
Applicability	The module is an elective compulsory module of the language training in the Distributed Systems Engineering Master's program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination is specified in the INF-DSE-20-LN-DE course catalogue of the Faculty of Computer Science.	
Credit points and grades	The module is worth 3 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each semester.	
Workload	The workload comprises 90 hours.	
Module duration	The module lasts for one semester.	

Module number	Module name	Module coordinator
INF-DSE-20-LN-EN	English – Advanced Professionals	Studies Coordinator dse-info@mailbox.tu-dresden.de
Learning goals	Upon successful completion of the module, participants will be able to write and present high-quality texts and papers in English at level C1/C2 of the Common European Framework of Reference for Languages (CEFR) and to lead discussions in English in full professional fluency.	
Content	Depending on the preferences of the participants, the module includes: Academic Writing, Advanced Professional Writing, Advanced Grammar, Project Management and Administration.	
Teaching and learning methods	The module comprises language courses amounting to 2 SWS as well as independent study. The required number of courses are to be chosen from the INF-DSE-20-LN-EN course catalogue of the Faculty of Computer Science. The catalogue, including the required examined assessments, as well as the weighting of the grades of the examined assessments will be made available at the beginning of the semester as is customary at the faculty.	
Prerequisites		
Applicability	The module is an elective compulsory module of the language training in the Distributed Systems Engineering Master’s program.	
Requirements for earning credit points	Credit points are awarded upon passing the module examination. The module examination is specified in the INF-DSE-20-LN-EN course catalogue of the Faculty of Computer Science.	
Credit points and grades	The module is worth 3 credit points. The module grade is calculated from the weighted average grade of the examined assessments as specified in the course catalogue.	
Frequency of the module	The module is offered each semester.	
Workload	The workload comprises 90 hours.	
Module duration	The module lasts for one semester.	