Attachment 1: Module Description

Compulsory Modules of Basic Education

Module Number	**Module Name**	**Responsible Lecturer**
CMS-SKL	Soft Skills	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	Students possess the scientific working methods and are familiar with the principles of good scientific practice. They can write expert communications in the German or the English language and understand simple conversations in both languages.	
Contents	The module includes enhancements of German and English language proficiency at level C1 of the European Framework of Reference for Languages, as well as training in good academic practice and scientific methodology.	
Teaching and Learning Methods	The module comprises courses totaling 4 SWS[1] and self-study. At least 2 SWS language courses have to be chosen from the language education program of Technische Universität Dresden (Catalogue of the Language and Culture Learning Center, LSK). One is free to choose 2 SWS worth of lectures, exercises, tutorials, seminars, internships, project work or language courses specified in the CMS-SKL catalogue. The courses in this module are offered in both English and German. The catalogue will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, including the language of the courses, the necessary examination performances and the weighting of the grades.	
Prerequisites for Participation	None	
Usability	This module is a compulsory module, within the Master's of Computational Modelling and Simulation programme.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examination performances specified in the CMS-SKL catalogue.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade results from the average of the grades of the examination performances, weighted according to the catalogue CMS-SKL.	
Frequency of the Module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 150 hours.	

[1] Translator's note: SWS = Hours per week

Duration of the Module	The module takes one semester.

Module Number	**Module Name**	**Responsible Lecturer**
CMS-PROJ	Research Project	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	The students master the practical application and transfer of acquired knowledge in an independent scientific project.	
Contents	The module includes a computer-aided modelling or simulation project on a topic of the student's choice in Computational Life Science, Computational Mathematics, Visual Computing, Computational Modelling in Energy Economics and Computational Engineering.	
Teaching and Learning Methods	The module includes the project processing in the scope of 12 SWS worth of seminars and the self-study.	
Prerequisites for Participation	None.	
Usability	This module is a compulsory module, within the Master's of Computational Modelling and Simulation programme.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of completing a project of 14 weeks, and a presentation.	
Credit Points and Grades	The module allows for the earning of 15 credit points. The module grade is calculated from the weighted average of the grades on the examination performances. The project work is weighted twice and the presentation is weighted once.	
Frequency of the Module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 450 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-SEM	Literature Review in Computational Modelling	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	Students will be able to independently develop the contents of scientific publications from at least two different fields of Computational Modelling and Simulation and present them to third parties in a comprehensible manner, and critically analyse the acquired knowledge. They are able to critically analyse and communicate the application of computational modelling methods in two different application areas and to recognise cross-application approaches.	
Contents	Analysis and discussion of scientific publications on a topic of the student's choice in the fields of Computational Life Science, Computational Mathematics, Visual Computing, Computational Modelling in Energy Economics and Computational Engineering.	
Teaching and Learning Methods	The module includes 4 SWS worth of seminars and the self-study. The courses are to be selected from the CMS-SEM catalogue to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, including the language of the course.	
Prerequisites for Participation		
Usability	This module is a compulsory module, within the Master's of Computational Modelling and Simulation programme.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examination performances specified in the CMS-SEM catalogue.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module score is the unweighted average of the grades earned in the individual examination performances.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	**Module Name**	**Responsible Lecturer**
CMS-COR-MLD	Machine Learning and Data Mining	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	Upon completing the module, students master the basics and handling of forward problems and inverse problems in computer-aided science. They intuitively comprehend the meaning and definition of these two problem formulations, as well as the relationship with generative and discriminative approaches in Statistics. They know the theoretical connections between these two formulations, as given by the Theorem of Bayes and the Euler-Lagrange equations. For forward problems, students know what verification and validation mean, and can apply these in practice. For inverse problems, students are familiar with the basics of machine learning, in particular supervised and unsupervised approaches, as well as the concepts of overfitting and cross validation.	
Contents	Mathematical formulation of forward problems and inverse problems, generative and discriminative modelling approaches, Bayes theorem, Euler-Lagrange equations of optimisation, verification and validation of models and simulations, basics of machine learning, supervised learning, unsupervised learning, overfitting, cross validation, learning as an optimisation problem, basics of neural networks.	
Teaching and Learning Methods	The module includes 2 SWS worth of lectures, 2 SWS worth of exercises and the self-study.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	In the Computational Modelling and Simulation Master's programme, the module is one of six compulsory elective modules (for students of Computational Life Science: five), of which three must be chosen. This module fulfils the prerequisites for the CMS-	

	EE-SCEE and CMS-EE-REEP modules.
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. If there are more than 10 registered students, the module examination consists of a written examination, with a duration of 90 minutes. If there are 10 or fewer registered students, it consists of an oral examination as an individual examination performance amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.
Frequency of the Module	The module is offered each year during the winter semester.
Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Module Number	**Module Name**	**Responsible Lecturer**
CMS-COR-HPC	Parallel Programming and High-Performance Computing	Prof. Dr. Wolfgang Nagel wolfgang.nagel@tu-dresden.de
Qualification Objectives	Upon completing this module, the students will acquire the basics of parallel programming and high performance scientific computing.	
Contents	The contents of the module include the design and architecture of numerical simulation codes, as well as computer programmes for data analysis. Furthermore, they include practical parts for the implementation of examples on existing HPC architectures in a high level language with different parallelisation models such as e.g. MPI, multi-threading or CUDA.	
Teaching and Learning Methods	The module includes 2 SWS worth of lectures, 2 SWS worth of exercises and the self-study.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	In the Computational Modelling and Simulation Master's programme, the module is one of six compulsory elective modules (for students of Computational Life Science: five), of which three must be chosen. This module fulfils the prerequisites for the CMS-EE-SCEE and CMS-EE-REEP modules.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. If there are more than 10 registered students, the module examination consists of a written examination, with a duration of 90 minutes. If there are 10 or fewer registered students, it consists of an oral examination as an individual examination performance amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	

Frequency of the Module	The module is offered each year during the winter semester.
Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Module Number	**Module Name**	**Responsible Lecturer**
CMS-COR-NUM	Basic Numerical Methods	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	Upon completin this module, the students will acquire the basics of numerical mathematics and numerical simulation methods. This includes the theoretical understanding of how a computer calculates with finite floating-point numbers and what kind of errors and inaccuracies may arise from these, and how to reduce or control them same. They will be familiar with basic numerical methods for modelling and simulating statistical models, linear algebra models, and ordinary and partial differential equations. They will be able to estimate the approximation errors of the methods and determine the algorithmic intensity, and will be able to implement these methods themselves.	
Contents	Floating point arithmetic, rounding errors, cancellation, numerical interpolation (Lagrange, Newton, Splines), Taylor developments, finite differences and their approximation errors, explicit and implicit time integrators, direct and iterative algorithms for matrix inversion, matrix decomposition (LU), solution for the Poisson equation.	
Teaching and Learning Methods	The module includes 2 SWS worth of lectures, 2 SWS worth of exercises and the self-study.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	In the Computational Modelling and Simulation Master's programme, the module is one of six compulsory elective modules (for students of Computational Life Science: five), of which three must be chosen. Completion of this fulfills the prerequisite for the module CMS-CE-CFD.	
Requirements for the Awarding of Crediz	The credit points are awarded if the module examination is passed. If there are more than 10 registered students, the module	

Points	examination consists of a written examination, with a duration of 90 minutes. If there are 10 or fewer registered students, it consists of an oral examination as an individual examination performance amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.
Frequency of the Module	The module is offered each year during the winter semester.
Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Module Number	**Module Name**	**Responsible Lecturer**
CMS-COR-SAP	Stochastics and Probability	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	Upon completing the module, the students master the basics of stochastic modelling and simulation.	
Contents	Conditional probabilities, normal distributions, and scale-free distributions; Markov chains and their matrix representation, mixing times and Perron-Frobenius theory; Applications of Markov chains, such as the PageRank algorithm; Monte Carlo Methods: Convergence, Law of Large Numbers, Variance Reduction, Importance Sampling, Markov Chains Monte-Carlo Using Metropolis-Hastings & Gibbs Samplers; Random processes and Brownian motion: properties in 2, 3 and more dimensions, connection to the diffusion equation, Levy processes and anomalous diffusion; Stochastic differential equations (SDEs): Nonlinear transformations of Brownian motion (Ito calculus), Ornstein-Uhlenbeck process and other solvable equations; Examples from population dynamics, genetics, protein kinetics, etc.; Numerical simulation of SDEs: strong and weak error, Euler-Maruyama scheme, Milstein scheme.	
Teaching and Learning Methods	The module includes 2 SWS worth of lectures, 1 SWS worth of exercises, 1 SWS worth of tutorials and the self-study.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	In the Computational Modelling and Simulation Master's programme, the module is one of six compulsory elective modules (for students of Computational Life Science: five), of which three must be chosen.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. If there are more than 10 registered students, the module examination consists of a written examination, with a duration of	

	90 minutes. If there are 10 or fewer registered students, it consists of an oral examination as an individual examination performance amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.
Frequency of the Module	The module is offered each year during the winter semester.
Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Module Number	Module Name	Responsible Lecturer
CMS-COR-VIZ	Data Visualisation	Prof. Dr. Stefan Gumhold stefan.gumhold@tu-dresden.de
Qualification Objectives	Upon completing this module, the students will acquire the basics and practices of scientific visualisation of measurement and experimental data, as well as simulation results. They know the basics of visual perception and their influence on the design of visualisations. Students can confidently specify data by dimension, feature types, and structure and select appropriate visual attributes for a given specification. They know the most important visualisation forms for 2-, 3- and multidimensional observation spaces, as well as for scalar, vectorial, tensor-valued and multidimensional features. They are able to select suitable techniques for the respective visualisation task. Students are familiar with basic presentation- and interaction techniques and can thoroughly implement them in an interactive visual analysis system. They know the most important visualisation frameworks, have gathered practical experience and are able to select these tasks appropriately.	
Contents	The contents of the module are the basics of data visualisation, which deals with the mapping of data of different types on visual attributes, and builds on knowledge about the visual perception of humans.	
Teaching and Learning Methods	The module includes 2 SWS worth of lectures, 2 SWS worth of exercises and the self-study.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, basic techniques of data analysis and linear algebra (vector and matrix calculation) at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	In the Computational Modelling and Simulation Master's programme, the module is one of six compulsory elective modules (for students of Computational Life Science: five), of which three must be chosen.	

Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. If there are more than 10 registered students, the module examination consists of a written examination, with a duration of 90 minutes. If there are 10 or fewer registered students, it consists of an oral examination as an individual examination performance amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.
Frequency of the Module	The module is offered each year during the winter semester.
Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Module Number	**Module Name**	**Responsible Lecturer**
CMS-COR-SED	Statistical Principles and Experimental Design	Prof. Dr. M.D. Ingo Röder ingo.roeder@tu-dresden.de
Qualification Objectives	Upon completing the module, the students master the methodical and practical basics of statistical data analysis and modelling, as well as the planning of experiments. They are able to describe and analyse data using statistical methods and interpret their results correctly. Furthermore, they gain the ability to plan experiments in such a way that a subsequent data evaluation in the context of the respective question is meaningful and efficient.	
Contents	Contents of the module are basic terms of probability theory (e.g. random variables, distributions, threshold sets), schools of statistical inference (e.g. frequentist, Bayesian, likelihood-based), estimation methods (e.g. point and interval estimators), principle and application statistical tests (e.g. significance and fit test), concept and application of statistical models (e.g. linear and generalized linear models), variance components and types, principles of experimental design (e.g. replication, randomisation, block formation), special designs (e.g. factorial designs, block designs), sample size planning.	
Teaching and Learning Methods	The module includes 2 SWS worth of lectures, 2 SWS worth of exercises and the self-study.	
Prerequisites for Participation	Basic knowledge in the rudiments of probability calculus, analysis of functions of one and more variables, linear algebra (vector and matrix calculation), as well as basic knowledge of computer programming at the Bachelor's level. Students can prepare for the module with the following literature: Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008; Tamás Rudas: Handbook of Probability: Theory and Applications, Sage Publications, Inc., 2008	
Usability	In the Computational Modelling and Simulation Master's programme, the module is one of six compulsory elective modules of which three must be chosen. It cannot be selected by students of the Tracks Computational Life Science. This module is a compulsory module, within the Master's of Track Computational Science programme.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. If there are more than 10 registered students, the module examination consists of a written examination, with a duration of 90 minutes. If there are 10 or fewer registered students, it consists of an oral examination as an individual examination	

	performance amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.
Frequency of the Module	The module is offered each year during the Winter semester.
Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Modules in the track Computational Life Science

Module Number	**Module Name**	**Responsible Lecturer**
CMS-CLS-ELG	Computational Life Science Basics	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	The students master the basic skills for the application of computer-aided modelling and simulation in the engineering sciences. They have in-depth knowledge of the application domain and are able to intuitively present simulation results. They have in-depth knowledge of the application domain and are able to intuitively present simulation results.	
Contents	The contents of the module can be chosen according to the student's focus: the basics of mechanics, the basics of automation, computer science methods for graphical representation and control of simulations, as well as flow simulation.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work in the amount of 8 SWS (semester weeks) and self-study. The courses are to be selected from the CMS-CMA-ELG catalogue to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, including the language of the lecture, the necessary examination performances and the weighting of the grades.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	The module is a compulsory module for students of Computational Life Science in the Computational Modelling and Simulation Master's programme.	
Requirements for the Awarding of Credit	The credit points are awarded if the module examination is passed. The module examination consists of the examinations	

Points	specified in the CMS-CMA-ELG catalogue.
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade results from the average of the grades of the examinations performances, weighted according to the catalogue CMS-CMA-ELG.
Frequency of the Module	The module is offered every academic year, starting in the summer semester.
Workload	The workload is a total of 300 hours.
Duration of the Module	The module takes two semesters to complete.

Module Number	Module Name	Responsible Lecturer
CMS-CLS-IBC	Introduction to Biochemistry	Prof. Dr. Francis Schwarze francis.stewart@tu-dresden.de
Qualification Objectives	After completing the module, students will have knowledge of the basics of biochemistry, organic chemistry of biological molecules, their structure and their biosynthesis, primary metabolic networks, enzymology, gene expression, mutagenesis and the genetic architecture of selected biosyntheses. Students are able to explain nutrient and food-related meal planning and implement them independently.	
Contents	The module includes the presentation of the most important macromolecules of the cell, its molecular building blocks, the biosynthesis and degradation of macromolecules. Furthermore, the module encompasses the flow of information in the cell from DNA to protein and methods for manipulating the genetic information.	
Teaching and Learning Methods	2 SWS lectures and 2 SWS exercises, as well as self-study.	
Prerequisites for Participation	None.	
Usability	The module is a compulsory module for students of Computational Life Science in the Computational Modelling and Simulation Master's programme.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of an ungraded colloquium of 45 minutes.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CLS-ABI	Applied Bioinformatics	Prof. Dr. Michael Schroeder michael.schroeder@tu-dresden.de
Qualification Objectives	At the end of this module, the students will acquire the methodological principles of the methodical basics of sequence analysis and other bioinformatic algorithms. They know essential algorithms and can classify them, analyse them and judge their goal-setting and efficiency.	
Contents	Contents of the module are the basics of sequence comparison. These include algorithms such as e.g. Levenshtein distance, dynamic programming, global and local alignment, substitution matrices, multiple sequence alignment and others.	
Teaching and Learning Methods	The module includes 2 SWS lectures, 2 SWS exercises and self-study.	
Prerequisites for Participation	Knowledge in sequential computer programming, linear algebra (vector and matrix calculation), as well as probability calculation and bachelor level statistics is required. Students can prepare for the module with the following literature: Schildt: C++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Alberts, Bray, Hopkin, Johnson, Roberts, Lewis: Essenial Cell Biology, Taylor & Francis, 2013 Jaynes: Probability Theory: The Logic of Science, Cambridge University Press, 2003.	
Usability	The module is a compulsory module for students of Computational Life Science in the Computational Modelling and Simulation Master's programme.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of an ungraded colloquium of 45 minutes.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CLS-ELV	Computational Life Science Advanced	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	After completing the module, students will have in-depth skills in the application of computer-aided modelling and simulation in life sciences, extended to complex spatio-temporal systems. They have in-depth knowledge of the application domain and are able to study mixed models using self-implemented simulation methods, model complex systems independently and test and validate the models. Students are familiar with the application domain to the extent that they can hold solution-oriented project discussions with partners from the engineering sciences.	
Contents	The contents of the module are optional, depending on the student's focus: biomechanics, particle methods, mathematical and computational biology, cognitive neurology, advanced biophysics, advanced machine learning, complex biological networks, multiphase simulation, advanced genomics, biological hydrodynamics.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work to the extent of 8 SWS and self-study. The courses are to be selected from the CMS-CMA-ELV catalogue to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, including the language of the course, the necessary examination performances and the weighting of the grades.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of Computational Life Science in the Computational Modelling and Simulation Master's program.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-CMA-ELG catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade results from the average of the grades of the examination performances, weighted according to the catalogue CMS-CMA-ELG.	
Frequency of the Module	The module is offered each academic year during the winter semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes one semester to complete.	

Module Number	Module Name	Responsible Lecturer
CMS-CLS-TEA	Computational Life Science Teamproject	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	The students master the practical application and transfer of acquired knowledge in a team project together with students from other fields of study. The students master the literature research and the use of scientific information sources. The students have cross-application skills and competencies in teamwork (project management and social skills teamwork).	
Contents	The contents of the module are the interdisciplinary application and communication of a work topic of the student's choice in the fields of biology, biochemistry, biophysics, biomechanics, particle methods, mathematical and computational biology, cognitive neurology, computer science methods for the graphical representation and control of simulations, machine learning, biological networks, genomics, and flow simulation.	
Teaching and Learning Methods	Project work in the scope of 8 SWS and self-study.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of Computational Life Science in the Computational Modelling and Simulation Master's program.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a project work of 12 weeks, a project report of 80 hours and a colloquium of 30 minutes.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade results from the unweighted average of the grades of the examinations.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CLS-MOS	Modelling and Simulation in Biology	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification Objectives	After completing the module, the students master the modelling and simulation of biological systems in space and time. They are able to independently derive models of biological processes, formulate them mathematically and simulate them numerically in the computer. The corresponding simulation codes can be designed and implemented independently.	
Contents	The content of the module includes: model scaling, dimensional analysis, dynamic system storage and flow modelling, spatiotemporal systems volume control model, spatio-temporal finite-difference simulation, spatiotemporal system particle methods, cellular automata and agent-based discrete systems, applications in diffusion, advection-diffusion, collective cell behavior, embryogenesis and tissue regeneration.	
Teaching and Learning Methods	2 SWS lectures and 2 SWS exercises as well as self-study.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of Computational Life Science in the Master's program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. For more than 10 registered students, the module examination consists of a written examination amounting to 120 minutes. For up to 10 registered students, it consists of an oral examination as individual examinations amounting to 30 minutes; this will be announced to the enrolled students at the end of the enrollment period.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered each year during the summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Modules inthe track Computational Mathematics

Module Number	**Module Name**	**Responsible Lecturer**
CMS-CMA-ELG	Computational Mathematics Basics	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	The students master the basic competences for the application of computer-aided modelling and simulation in mathematics. They have in-depth knowledge of the application domain and are able to intuitively present simulation results. They have in-depth knowledge of the application domain and are able to intuitively present simulation results.	
Contents	The module includes an introduction to the mathematical field computational mathematics.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work in the amount of 8 SWS and self-study. The courses are to be selected from the CMS-CMA-ELG catalogue to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, in writing, including the language of the course, the necessary examinations and the weighting of the grades.	
Prerequisites for Participation	Knowledge at the Bachelor level is required in sequential computer programming, algorithms and data structures, analysis of functions of one and more variables, linear algebra (vector and matrix calculation) as well as probability calculus and statistics. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	The module is a compulsory module for students of the track computational mathematics in the master's Program computational Modelling and simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-CMA-ELG catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade results from the average of the grades of the examinations	

	performances, weighted according to the catalogue CMS-CMA-ELG.
Frequency of the Module	The module is offered every academic year, starting in the winter semester.
Workload	The workload is a total of 300 hours.
Duration of the Module	The module takes two semesters to complete.

Module Number	Module Name	Responsible Lecturer
CMS-CMA-FEM	Finite Element Method	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	The students master the theory and practice of the finite element method (FEM) for the numerical solution of partial differential equations. The students have a systematic understanding of the theory of FEM, especially of convergence results. They have knowledge of algorithmic questions and implementation aspects in software, have basic knowledge and experience in the modelling of application-related problems, for example in the fields of fluid mechanics and materials science. In addition, the students are able to independently analyse specific problems of selected areas of application and to solve them with suitable FEM procedures.	
Contents	The module contents cover all essential aspects of the finite element method, including the theory, the implementation and their applications.	
Teaching and Learning Methods	Lectures in the scope of 3 SWS and exercises in the scope of 1 SWS and self-study.	
Prerequisites for Participation	Numerical Competences of Ordinary Differential Equations (See, for example, Gerald, Wheatley: Applied Numerical Analysis (chapters 1-6), Pearson, 2003, or Ferziger: Numerical Methods for Engineering Application (Chapters 1-5), Wiley, 1998)	
Usability	The module is a compulsory module for students of the Computational Modelling and Simulation master's degree program Tracks Computational Mathematics and the track Computational Engineering. The module creates the prerequisites for the modules CMS-CMA-MODSEM and CMS-CMA-ELV2.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. For more than 10 registered students, the module examination consists of a written examination amounting to 120 minutes. For up to 10 registered students, it consists of an oral examination as a group examination with up to 3 students lasting 20 minutes; this will be announced to the enrolled students at the end of the enrollment period. Exam preparation is an exercise of 10 hours.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered each year during the winter semester.	

Workload	The workload is a total of 150 hours.
Duration of the Module	The module takes one semester.

Module Number	Module Name	Responsible Lecturer
CMS-CMA-MODSEM	Modelling Case Studies	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	After completing the module, students master the mathematical modelling and treatment of problems from application areas, preferably by means of a description by partial differential equations. The students have a systematic understanding of how application problems can be formulated mathematically, suitably simplified and numerically treated. They are able to present their results comprehensibly even to non-mathematicians.	
Contents	Content of the module are case studies to transfer mathematical modelling and simulation to specific application problems.	
Teaching and Learning Methods	The module comprises 4 SWS seminars, 90-hour project work and self-study.	
Requirements for participation	Competences on the partial differential equations are required, as they can be acquired in the module CMS-CMA-FEM.	
Usability	The module is a compulsory module in the Master's programme Computational Modelling and Simulation for students of Computational Mathematics.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module exam consists of an un-graded colloquium of 60 minutes.	
Credit points and Grades	The module allows one to earn 10 credit points. The module is only graded "passed" or "failed".	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CMA-PROJ	Computational Mathematics Project	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	The students master the autonomous processing of a project with tasks from applications of mathematics in other areas, the investigation or improvement of algorithms and the generalization or specialization of mathematical results. The students are able to familiarize themselves with the task in a project group, to discuss possible ways and solutions and to define steps to fulfill the task, to acquire the necessary theoretical detailed knowledge and computational aids, to contribute their respective strengths to the project and the to use limited time resources efficiently.	
Contents	The module includes the investigation or improvement of algorithms and the generalisation or specialisation of mathematical results.	
Teaching and Learning Methods	The module includes 2 SWS seminars, 60 hours of project work and self-study.	
Requirements for participation		
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The performance credit are awarded if the module examination is passed. The module exam consists of an ungraded colloquium of 20 minutes.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module is only graded "passed" or "failed".	
Frequency of the module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes 1 semester to complete.	

Module Number	Module Name	Responsible Lecturer
CMS-CMA-ELV1	Advanced Computational Mathematics	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	The students have in-depth competencies for the application of computer-aided modelling and simulation in mathematics. They know the application domain to the extent that they are able to study complex models by means of self-implemented simulation methods and to independently model mathematical relationships, to test and validate the models.	
Contents	The contents of the module are in-depth questions from the mathematical field Computational Mathematics.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project workto the extent of 8 SWS and self-study. The courses are to be selected from the CMS-CMA-ELV1 catalogue to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, in writing, including the language of the course, the necessary examinations and the weighting of the grades.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-CMA-ELV1 catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is the average of the grades of examinations weighted according to the catalogue CMS-CMA-ELV1.	
Frequency of the Module	The module is offered each academic year, starting in the summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes two semesters to complete.	

Module Number	Module Name	Responsible Lecturer
CMS-CMA-ELV2	Computational Mathematics Applications	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	The students are able to transfer their acquired competencies of computational modelling and simulation in mathematics to the application domain. They are able to study complex models using self-implemented simulation methods and to model mathematical correlations independently and to test and validate the models. In particular, the students are able to grasp a complex mathematical problem independently in models and to explore it in communication with experts of the application domain computer supported.	
Contents	The contents of the module are in-depth questions from the mathematical field Computational Mathematics application domain.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work in the amount of 8 SWS and self-study. The courses are to be selected from the CMS-CMA-ELV2 catalog to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, in writing, including the language of the course, the necessary examinations and the weighting of the grades.	
Prerequisites for Participation	The competencies to be acquired in the CMS-CMA-FEM module are assumed.	
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-CMA-ELV2 catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is the average of the grades of examinations weighted according to the catalogue CMS-CMA-ELV2.	
Frequency of the Module	The module is offered each academic year, starting in the summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes two semesters to complete.	

Modules in the Track Visual Computing

Module Number	**Module Name**	**Responsible Lecturer**
CMS-VC-ELG	Visual Computing Basics	Prof. Dr. Stefan Gumhold stefan.gumhold@tu-dresden.de
Qualification Objectives	The students have the basic skills for the digital representation and processing of visual data. They have in-depth knowledge in two areas of Visual Computing and are able to apply and implement the methods taught therein.	
Contents	The contents of the module are the basics of digital representation and processing of visual data.	
Teaching and Learning Methods	The module includes lectures and exercises of 4 SWS each as well as self-study. The courses are to be selected from the catalogue CMS-VC-ELG to the specified extent; this will be announced including the course language, the required examination achievements and weights of the grades at the beginning of the semester as usual at the Faculty of Computer Science.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level are required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	The module is a compulsory module for students of Tracks Visual Computing in the Master's Program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-VC-ELG catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade results from the average of the grades of the examinations	

	performances, weighted according to the catalogue CMS-VC-ELG.
Frequency of the Module	The module is offered each year during the winter semester.
Workload	The workload is a total of 300 hours.
Duration of the Module	The module takes one semester.

Module Number	Module Name	Responsible Lecturer
CMS-VC-ELV1	Advanced Visual Computing	Prof. Dr. Stefan Gumhold stefan.gumhold@tu-dresden.de
Qualification Objectives	Students have in-depth and specialized knowledge in the field of visual computing. They are able to select suitable solution methods for new tasks and develop existing methods.	
Contents	Contents of the module are in-depth questions from the field of Visual Computing.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work in the amount of 12 SWS and self-study. The courses are to be selected from the CMS-VC-ELV1 catalogue to the specified extent; this will be announced as usual at the Faculty of Computer Science, at the beginning of each semester, in writing, including the language of the course, the necessary examinations and the weighting of the grades.	
Prerequisites for Participation	.	
Usability	The module is a compulsory module for students of the track Visual Computing in the Master's programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-VC-ELV1 catalogue.	
Credit Points and Grades	The module allows for the earning of 15 credit points. The module grade results from the average of the grades of the examinations performances, weighted according to the catalogue CMS-VC-ELV1.	
Frequency of the Module	The module is offered each academic year, starting in the summer semester.	
Workload	The workload is a total of 450 hours.	
Duration of the Module	The module takes two semesters to complete.	

Module Number	Module Name	Responsible Lecturer
CMS-VC-ELV2	Visual Computing Applications	Prof. Dr. Stefan Gumhold stefan.gumhold@tu-dresden.de
Qualification Objectives	The students have in-depth specialised and interdisciplinary knowledge in the field of visual computing. They are able to work on new, interdisciplinary tasks and to select suitable solution methods as well as to develop new solution methods.	
Contents	The contents of the module are research-related application problems of Visual Computing.	
Teaching and Learning Methods	The module comprises courses totaling 12 SWS and self-study. At least 2 SWS lectures and 2 SWS exercises from the CMS-VC-ELV2 catalogue are to be selected. 8 SWS are free to choose from the lectures given in the catalogue, exercises, seminars, internships and project work; this is announced including the language of the course, the required examinations and weights of the grades at the beginning of the semester as usual at the Faculty of Computer Science.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the track Visual Computing in the Master's program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examinations specified in the CMS-VC-ELV2 catalogue.	
Credit Points and Grades	The module allows for the earning of 15 credit points. The module grade results from the average of the grades of the examinations performances, weighted according to the catalogue CMS-VC-ELV2.	
Frequency of the Module	The module is offered each academic year, starting in the summer semester.	
Workload	The workload is a total of 450 hours.	
Duration of the Module	The module takes two semesters to complete.	

Module Number	Module Name	Responsible Lecturer
CMS-VC-TEA	Visual Computing Teamproject	Prof. Dr. Stefan Gumhold stefan.gumhold@tu-dresden.de
Qualification Objectives	Students are able to work on a complex, research-oriented project that requires competences from several areas of visual computing. The students are able to solve a larger, typically interdisciplinary task in the field of visual computing in a group. The students master the literature research and the use of scientific information sources. They have in-depth expertise as well as extensive methodological and social skills in project management and teamwork.	
Contents	Contents of the module are the interdisciplinary application and communication of a working topic in the fields of digital representation and processing of visual data.	
Teaching and Learning Methods	Project work amounting to 8 SWS and self-study.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the track Visual Computing in the Master's programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a project work of 12 weeks, a project report of 80 hours and a colloquium of 30 minutes.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade results from the unweighted average of the grades of the examinations.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes one semester.	

Modules in Computational Modelling in Energy Economics

Module Number	**Module Name**	**Responsible Lecturer**
CMS-EE-EPM	Electric Power Markets	Prof. Dr. Dominik Möst dominik.moest@tu-dresden.de
Qualification Objectives	The students know the basics and methods of the economic theory of the electricity sector. They are able to analyse the electricity sector from an economic perspective.	
Contents	The module addresses techno-economic issues in the electricity industry. It includes methods, knowledge and interdependencies in the fields of energy market structures, techno-economic analysis as well as the modelling and optimization of energy systems and modelling of energy markets.	
Teaching and Learning Methods	The module includes lectures amounting to 2 SWS, exercises amounting to 2 SWS and self-study	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Programme Computational Modelling and Simulation. This module creates the requirements for the CMS-EE-SCEE, CMS-EE-LSEE and CMS-EE-REEP modules.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a written final examination of 90 minutes. If there are fewer than 10 registered students, the examination consists of an oral examination as an individual examination of 45 minutes. This will be announced to the registered students at the end of the registration period as usual at the Faculty of Computer Science.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-EE-EL1	Computational Modelling in Energy Economics Basics	Prof. Dr. Dominik Möst dominik.moest@tu-dresden.de
Qualification Objectives	The students master the basic skills for the application of computer-aided modelling and simulation in energy market modelling. You have in-depth knowledge of the application domain and are able to present simulation results intuitively. The students are familiar with concrete economic issues and know the basics of the application discipline as well as its technical vocabulary.	
Contents	The contents of the module can be selected according to the focus of the student: numerical methods, computer methods for graphical representation and control of simulations, computer-aided simulation and advanced programming.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, practical courses and project work in the scope of 8 SWS and self-study. The courses are to be selected from the catalogue CMS-EE-EL1 to the specified extent; this will be announced including the course language, the required examination achievements and weights of the grades at the beginning of the semester as is customary at the Faculty of Computer Science.	
Prerequisites for Participation	Knowledge in sequential computer programming, linear algebra (vector and matrix calculation) as well as probability calculation and bachelor level statistics are required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examination services specified in the CMS-EE-EL1 catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is calculated from the weighted average of the grades of the examination performances according to the CMS-EE-EL1	

	catalogue.
Frequency of the Module	The module is offered every academic year, starting in the winter semester.
Workload	The workload is a total of 300 hours.
Duration of the Module	The module takes two semesters to complete.

Module Number	Module Name	Responsible Lecturer
CMS-EE-SCEE	Case Studies in Energy Economics	Prof. Dr. Dominik Möst dominik.moest@tu-dresden.de
Qualification Objectives	After completing this module, students will be able to independently answer complex questions of energy and risk management or resource economics and to create and apply their own concepts for integrating economic aspects into decisions. In addition, the students are able to work in teams, they master literature research and the use of scientific information sources.	
Contents	The module addresses current techno-economic issues in the energy industry. It covers the modelling of commodity markets, the mapping and modelling of uncertainties in the energy industry or the economic modelling of electricity networks.	
Teaching and Learning Methods	The module includes 2 SWS seminars and self-study.	
Prerequisites for Participation	Knowledge and competencies are expected as they can be acquired in the modules CMS-EE-EPM, CMS-COR-HPC and CMS-COR-MLD.	
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a seminar paper lasting 60 hours and a colloquium lasting 30 minutes.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is calculated from the unweighted average of the grades of the two exam performances.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-EE-LSEE	Literature Studies in Energy Economics	Prof. Dr. Dominik Möst dominik.moest@tu-dresden.de
Qualification Objectives	The students can independently search and evaluate the scientific literature in the field of the energy industry and present the results in an understandable way.	
Contents	The module addresses in-depth techno-economic issues in the energy industry, in-depth modelling of commodity markets, in-depth mapping and modelling of uncertainties in the energy industry and in-depth economic modelling of electricity networks.	
Teaching and Learning Methods	The module includes 2 SWS seminars and self-study.	
Prerequisites for Participation	The knowledge and skills to be acquired in the CMS-EE-EPM module are assumed.	
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a seminar paper lasting 90 hours and an ungraded colloquium of 30 minutes.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade is derived from the unweighted average of the grades of the examination performances, taking into account § 12 paragraph 1 sentence 5 PO.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-EE-REEP	Resource Economics and Environmental Policy	Prof. Dr. Dominik Möst dominik.moest@tu-dresden.de
Qualification Objectives	The students know and master the theory of exhaustible resources. They are able to answer questions about market and price structures on raw material markets and to apply and critically reflect on optimisation methods in the energy industry.	
Contents	The module contains the basics of resource economics and environmental policy. These include current and applied theories and models of the subject areas, such as the hotel rule. The module also covers the basics of environmental policy tax instruments.	
Teaching and Learning Methods	The module includes lectures of 2 SWS, exercises of 2 SWS, project work of 2 SWS and self-study.	
Prerequisites for Participation	The knowledge and skills to be acquired in the modules CMS-EE-EPM, CMS-COR-HPC and CMS-COR-MLD are required.	
Usability	The module is a compulsory module for students of the track Computational Modelling in Energy Economics in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a written examination lasting 90 minutes (examination achievement I) and a project work lasting 150 hours (examination achievement II). For up to 10 registered students, examination achievement I consists of an oral examination as an individual examination lasting 45 minutes; this may be announced to the registered students at the end of the registration period.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is calculated from the weighted average of the grades of the examination achievements. Examination achievement I is weighted twice and examination achievement II is weighted once.	
Frequency of the Module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-EE-EL2	Computational Modelling in Energy Economics Advanced	Prof. Dr. Dominik Möst dominik.moest@tu-dresden.de
Qualification Objectives	The students have in-depth skills in the application of computer-aided modelling and simulation in energy market modelling, extended to complex techno-economic systems. They know the application domain to the extent that they are able to study models using self-implemented simulation methods, to model complex market economy models independently and to test and validate the models. You can independently conduct project discussions with partners from the economic sciences.	
Contents	The contents of the module can be chosen according to the focus of the student: in-depth knowledge of numerical methods, supplementary computer science methods for graphical representation and control of simulations, computer-aided simulation and advanced programming.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work in the amount of 8 SWS and self-study. The courses are to be selected from the catalogue CMS-EE-EL2 to the specified extent; this will be announced including the course language, the required examination achievements and weights of the grades at the beginning of the semester as is customary at the Faculty of Computer Science.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the track computational mathematics in the Master's Program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examination services specified in the CMS-EE-EL2 catalogue.	
Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is calculated from the weighted average of the grades of the examination performances according to the CMS-EE-EL2 catalogue.	
Frequency of the Module	The module is offered each academic year, starting in the summer semester.	
Workload	The workload is a total of 300 hours.	
Duration of the Module	The module takes two semesters to complete.	

Modules in the TrackComputational Engineering

Module Number	Module Name	**Responsible Lecturer**
CMS-CMA-FEM	Finite Element Method	Prof. Dr. Axel Voigt axel.voigt@tu-dresden.de
Qualification Objectives	The students master the theory and practice of the finite element method (FEM) for the numerical solution of partial differential equations. The students have a systematic understanding of the theory of FEM, especially of convergence results. They have knowledge of algorithmic questions and implementation aspects in software, have basic knowledge and experience in the modelling of application-related problems, for example in the fields of fluid mechanics and materials science. In addition, the students are able to independently analyse specific problems of selected areas of application and to solve them with suitable FEM procedures.	
Contents	The module contents cover all essential aspects of the finite element method, including the theory, the implementation and their applications.	
Teaching and Learning Methods	Lectures in the scope of 3 SWS and exercises in the scope of 1 SWS and self-study.	
Prerequisites for Participation	Numerical Competences of Ordinary Differential Equations (See, for example, Gerald, Wheatley: Applied Numerical Analysis (chapters 1-6), Pearson, 2003, or Ferziger: Numerical Methods for Engineering Application (Chapters 1-5), Wiley, 1998)	
Usability	The module is a compulsory module for students of the Master's Programme Computational Modelling and Simulation, Tracks Computational Mathematics and the Track Computational Engineering. The module creates the prerequisites for the modules CMS-CMA-MODSEM and CMS-CMA-ELV2.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. For more than 10 registered students, the module examination consists of a written examination amounting to 120 minutes. For up to 10 registered students, it consists of an oral examination as a group examination with up to 3 students lasting 20 minutes; this will be announced to the enrolled students at the end of the enrollment period. Preliminary examination is an exercise of 10 hours.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered each year during the winter semester.	
Workload	The workload is a total of 150 hours.	
Duration of the	The module takes one semester.	

Module	

Module Number	Module Name	Responsible Lecturer
CMS-CE-EL1	Computational Engineering Basics	Prof. Dr. Michael Beitelschmidt michael.beitelschmidt@tu-dresden.de
Qualification Objectives	The students master the basic skills for the application of computer-aided modelling and simulation in the engineering sciences. You have in-depth knowledge of the application domain and are able to present simulation results intuitively. The students know concrete constructive questions and know the basics of the application discipline as well as its technical vocabulary.	
Contents	The contents of the module can be chosen according to the focus of the student: the basics of mechanics, the basics of automation, computer science methods for graphical representation and control of simulations as well as flow simulation.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, tutorials, internships and project work in the amount of 8 SWS and self-study. The courses must be selected from the CMS-CE-EL1 catalogue to the specified extent; this will be announced at the beginning of the semester, as is customary at the Faculty of Computer Science, including the language of the course, the examination achievements required in each case and the weights of the grades.	
Prerequisites for Participation	Knowledge in sequential computer programming, algorithms and data structures, analysis of functions of one and several variables, linear algebra (vector and matrix calculation), as well as probability calculation and Statistics at the Bachelor's level is required. With the following literature, students can prepare for the module: Harel: Algorithmics - The Spirit of Computing, Addison-Wesley, 2004 Schildt: C ++ from the ground up, McGraw-Hill, 2003 Abelson, Hal; Sussman, Gerald Jay: Structure and Interpretation of Computer Programs. MIT Press, 1985; Cormen, Leiserson, Rivest & Stein: Introduction to Algorithms, 2nd Edition, MIT Press 2001; Lax, Terrell: Multivariable Calculus with Applications (Undergraduate Texts in Mathematics), Springer, 2018 Hefferon, Jim: Linear Algebra, http://joshua.smcvt.edu/linearalgebra/, 2008.	
Usability	The module is a compulsory module for students of the Computational Engineering track in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examination services specified in the CMS-CE-EL1 catalogue.	

Credit Points and Grades	The module allows one to earn 10 credit points. The module grade is calculated from the weighted average of the grades of the examination performances according to the CMS-CE-EL1 catalogue.
Frequency of the Module	The module is offered each academic year, starting in the summer semester.
Workload	The workload is a total of 300 hours.
Duration of the Module	The module takes two semesters to complete.

Module Number	**Module Name**	**Responsible Lecturer**
CMS-CE-AT	Advanced Topics in Finite Element Analysis Multifield Methods	Prof. Dr. Markus Kästner markus.kaestner@tu-dresden.de
Qualification Objectives	The students have sound knowledge and skills for numerical solutions of coupled field problems taking into account geometric and material nonlinearities.	
Contents	The module includes the finite element method for nonlinear material behavior taking into account finite deformations, continuum mechanical modelling, discretisation of weak and their linearisation as well as further aspects and applications of modelling coupled problems, adaptive and isogeometric discretisation and multi-scale modelling approaches.	
Teaching and Learning Methods	The module includes 2 SWS lectures, 2 SWS exercises and self-study.	
Prerequisites for Participation	Knowledge of linear algebra, numerics of differential equations, discrete structures and technical mechanics is required.	
Usability	The module is a compulsory module for students of the Computational Engineering track in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. For more than 25 registered students, the module examination consists of a written examination amounting to 120 minutes. For up to 25 registered students, it consists of an oral examination as an individual examination lasting 30 minutes; this may be announced to the registered students at the end of the registration period.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CE-MBD	Multibody Dynamics	Prof. Dr. Michael Beitelschmidt michael.beitelschmidt@tu-dresden.de
Qualification Objectives	The students understand the method of multi-body system simulation in order to calculate large movements of mechanical systems of rigid bodies in the time domain. The students master the methodology of setting up the motion equations of multi-body systems as well as their computational implementation for simple special cases. The students know the different algorithms of multi-body simulation, which are used in commercial programmes.	
Contents	Contents are kinematics and kinetics of rigid bodies, description of joints and bindings, the algorithms for setting up the equations of motion as well as solution methods.	
Teaching and Learning Methods	The module includes 2 SWS lectures, 2 SWS exercises and self-study.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the Computational Engineering track in the Master's Program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a written final examination of 90 minutes.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CE-MP	Multifield Problems	Prof. Dr. Thomas Wallmersperger thomas.wallmersperger@tu-dresden.de
Qualification Objectives	The students master (i) the basics for the investigation and calculation of multi-functional structures and structural elements and (ii) the fundamental relationships for the mathematical description of mechanical, thermal and electrical phenomena in deformable materials. Students are able to describe and calculate active structures.	
Contents	Contents of the module are the behaviour and formulations for different active materials and the calculation of "real" applications of multifunctional structures, basic equations of continuum mechanics and their extension to other physical phenomena as well as the modelling of field problems that couple different physical phenomena.	
Teaching and Learning Methods	The module includes 2 SWS lectures, 2 SWS exercises and self-study.	
Prerequisites for Participation	Knowledge of linear algebra, numerics of differential equations, discrete structures and technical mechanics is required.	
Usability	The module is a compulsory module for students of the Computational Engineering track in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of an examination paper lasting 120 minutes for more than 15 registered students. For up to 15 registered students, it consists of an oral examination as an individual examination lasting 30 minutes; this may be announced to the registered students at the end of the registration period.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered every summer semester.	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CE-CFD	Computational Fluid Dynamics	Prof. Dr. Jochen Fröhlich jochen.froehlich@tu-dresden.de
Qualification Objectives	The students master basic discretisation methods for the partial differential equations of fluid mechanics. They are able to create and apply these algorithms, analyse their central properties and validate them using suitable tests.	
Contents	The module includes the classification of differential equations, algorithms of finite differences and finite volumes, analysis of the numerical properties of the methods in terms of convergence, consistency and stability. Furthermore, solution methods for resulting systems of equations and selected applications are part of the module.	
Teaching and Learning Methods	The module includes 2 SWS lectures, 2 SWS exercises and self-study.	
Prerequisites for Participation	Basics of mathematics (analysis), basics of numerics as they can be acquired in the module CMS-COR-NUM, basics of fluid mechanics (conservation equations, similarity indicators)	
Usability	The module is a compulsory module for students of the Computational Engineering track in the Master's program Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of a written examination lasting 120 minutes. If there are less than 10 participants, the written examination may be replaced by an individual oral examination lasting 20 minutes, which will be announced to the registered students at the end of the registration period.	
Credit Points and Grades	This module allows for the earning of 5 credit points. The module grade corresponds to the grade of the examination performance.	
Frequency of the Module	The module is offered every winter semester	
Workload	The workload is a total of 150 hours.	
Duration of the Module	The module takes one semester.	

Module Number	Module Name	Responsible Lecturer
CMS-CE-EL2	Computational Engineering Advanced	Prof. Dr. Michael Beitelschmidt michael.beitelschmidt@tu-dresden.de
Qualification Objectives	After completing the module, students will have in-depth skills in the application of computer-aided modelling and simulation in engineering sciences, extended to complex spatio-temporal systems. You have in-depth knowledge of the application domain and are able to study mixed models using self-implemented simulation methods, model complex systems independently and test and validate the models. Students are familiar with the application domain to the extent that they can hold solution-oriented project discussions with partners from the engineering sciences.	
Contents	The contents of the module can be selected according to the focus of the students: in-depth aspects of mechanics, in-depth aspects of automation, in-depth aspects of computer science methods for graphical representation and control of simulations as well as flow simulation.	
Teaching and Learning Methods	The module includes lectures, exercises, seminars, practical courses and project work in the scope of 12 SWS and self-study. The courses must be selected from the CMS-CE-EL2 catalogue to the specified extent; this will be announced at the beginning of the semester, as is customary at the Faculty of Computer Science, including the language of the course, the examination achievements required in each case and the weights of the grades.	
Prerequisites for Participation		
Usability	The module is a compulsory module for students of the Computational Engineering track in the Master's Programme Computational Modelling and Simulation.	
Requirements for the Awarding of Credit Points	The credit points are awarded if the module examination is passed. The module examination consists of the examination services specified in the CMS-CE-EL2 catalogue.	
Credit Points and Grades	The module allows for the earning of 15 credit points. The module grade is calculated from the weighted average of the grades of the examination performances according to the CMS-CE-EL2 catalogue.	
Frequency of the Module	The module is offered each academic year, starting in the summer semester.	
Workload	The workload is a total of 450 hours.	

Duration of the Module	The module takes two semesters to complete.