Competence coverage matrix

GHENT UNIVERSITY
Bachelor of Science in Engineering

Computer Science Engineering

Academic year 2021-2022

Legend:
T=teaching methods
E=evaluation methods

			General Courses																				Courses Related to the Main Subject																							
			E001142 Basic Mathematics	E070080 Chemical Thermodynamics	E003043 Probability and Statistics	E066012 Materials Technology	E098512 Sustainability, Entrepreneurship and Ethics	E020061 Physics I	E001132 Mathematical Analysis I	E001460 Discrete Mathematics I	E070070 Chemistry: the Structure of Matter	E098513 Modelling, Making and Measuring	E015041 Informatics	E001222 Mathematical Analysis II	E000662 Geometry and Linear Algebra	E090320 Electrical Circuits and Networks	E040420 Mechanics of Materials	E020220 Physics II	E001321 Mathematical Analysis III	E005020 Analysis of Systems and Signals	E076040 Sustainable Business Operations	E034110 Computer Architecture	E012110 Communication Theory	E018110 Databases	E017610 Software Engineering	E019130 Multimedia Techniques	E002021 Formal Systems Modelling for Software	E099010 Cross-Course Project	E016020 Automata Theory	E017210 Computer Programming	E003110 Applied Probability	E001470 Discrete Mathematics II	E099111 Engineering Project	E018310 Algorithms and Data Structures	E008620 Communication Networks	E019010 Operating Systems	E031110 Digital Electronics
Competences in one/more scientific discipline(s)	Have a clear understanding of the basic sciences and basic engineering sciences, and have the ability to apply them in a creative and purposeful way in the chosen specific engineering discipline.	T 30 E 28	T E	T E		T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E		T	T E	T E	T E		T E	T E	T E	T E	T E	T E	T				T E
	Employ the basic sciences and techniques (statistics, ICT, CAD) in a creative and purposeful way.	T 8 E 7							T E	T E		T E	T E		T E							T							T E			T E				
	Know the common physical realization forms of information processing systems.	T 8 E 6											T E			T						T E	T E						T E			T E			T E	T
	Have a command of several data models, programming models and programming languages.	T 11 E 11			T E								T E									T E		T E	T E		T E	T E			T E	T E			T E
	Have a sound grasp of the important current applications and application areas of informatics.	T 6 E 3																						T E		T E			T			T	T E		T	
	Be familiar with models of system aspects and design methodologies of information processing systems.	T 10 E 9														T E							T E	T E		T E		T E	T E				T E		T E	T E
Scientific competences	Research and process technical and scientific information in a purposeful way.	T 11 E 8				T E	T E					T E	T E									T		T E	T E			T E		T E			T	T			
	Employ standard models, methods and techniques in assignments.	T 25 E 24	T E		T E	T E			T E			T E	T E	T E	T E	T E	T E	T E	T E	T E		T E	T E	T E	T E		T E	T E	T E	T E	T E		T	T E		T E	T E
	Schematize and model phenomena, processes, and systems.	T 18 E 16			T E			T E	T E	T E				T E	T E	T E		T E	T E	T E	T E		T	T E	T E		T E					T	T E			T E
	Justify decision-making processes on rational grounds.	T 17 E 16		T E	T	T E	T E				T E	T E		T E					T E				T E	T E			T E		T E			T E	T E	T E	T E	T E
Intellectual competences	Understand and structure learning experiences.	T 19 E 17	T E		T E	T E			T E				T E	T E	T E					T E	T E	T E	T E		T E		T E	T E	T E	T E		T	T			
	Think in a conceptual, analytical, system-oriented, problem-solving and synthesizing way at different levels of abstraction.	T 30 E 27	T E		T E	T E	T E	T	T E	T E		T E	T E	T E	T E	T E	T E	T E	T E	T E		T	T E	T E	T E		T E	T E	T E	T E	T E	T E	T	T E	T E	T E	
	Show precision, perseverance and critical reflection.	T 25 E 23	T E		T E	T E	T E		T E	T E		T E		T E	T E	T E		T E	T E	T E		T E	T E	T E	T E		T E	T E	T E	T E	T E	T E	T	T E	T E	T E	
	Show scientific curiosity.	T 15 E 11		T E		T E	T E	T			T E	T E		T E				T E		T E	T E	T		T E	T E			T E				T				
	Justify further studies or professional opportunities on rational grounds.	T 2 E 1				T														T E																
Competences in cooperation and communication	Master scientific and discipline-specific technical terminology (also in English).	T 21 E 19	T E	T E	T E	T E	T E	T	T E		T	T E		T E	T E			T E	T E			T E	T E	T E				T E				T E	T E	T E	T E	
	Carry out concrete assignments systematically.	T 9 E 7					T E					T E											T E	T E		T E		T E			T	T			
	Work as part of a team.	T 11 E 6					T E					T E										T	T		T E	T E		T E			T	T			T
	Report results verbally, in writing, and graphically.	T 12 E 12				T E	T E					T E											T E		T E	T E	T E	T E			T E	T E			T E
Societal competences	Act in an ethical and social way.	T 7 E 6				T E	T E													T E			T E					T E			T		T E		
	Be aware of the business aspects of the engineering discipline.	T 4 E 3					T E													T E								T					T E		
			W 6 E 6	W 4 E 4	W 8 E 7	W 12 E 10	W 12 E 12	W 5 E 2	W 8 E 8	W 5 E 5	W 4 E 3	W 11 E 11	W 8 E 8	W 9 E 9	W 8 E 8	W 7 E 6	W 3 E 3	W 5 E 5	W 8 E 8	W 8 E 8	W 5 E 5	W 11 E 5	W 13 E 10	W 15 E 15	W 12 E 12	W 4 E 4	W 8 E 8	W 13 E 13	W 6 E 6	W 17 E 15	W 5 E 5	W 3 E 3	W 18 E 7	W 14 E 8	W 6 E 6	W 9 E 8	W 9 E 7

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	lecture seminar: coached exercises lecture: plenary exercises	written examination	Being able to perform basic calculations quickly and efficiently by hand. Being able to formulate correctly and with mathematical precision. Being able to make a correct reasoning and to write it down in a structured way. To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors.
E070080 Chemical Thermodynamics	guided self-study seminar: coached exercises lecture	written examination open book examination	Application of the laws of thermodynamics on chemical systems. Calculation of the solubility of ionic compounds in aqueous solutions. Calculation of the pH of aqueous solutions. Understand and apply chemical equilibrium.
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	lecture project	participation assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E020061 Physics I	demonstration lecture	written examination	To understand the physical laws and concepts of the covered chapters. To be able to solve problems by applying these laws and concepts.
E001132 Mathematical Analysis I	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and integrability. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E001460 Discrete Mathematics I	guided self-study seminar: coached exercises practicum lecture	written examination open book examination	Distinguishing and applying fundamental algebraic and discrete structures. Being fluent in graph algorithms and applying them to real problem situations. Deploying deductively correct reasonings in an independent way. Evaluating logical reasonings with respect to correctness / identifying errors. Deploying mathematical reasoning and proof argumentation. Using basic concepts from set theory, group theory, combinatorics and graph theory.
E070070 Chemistry: the Structure of Matter	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform stoichiometric calculations. Identify and describe the different types of intermolecular interactions. Being able to determine the molecular geometry of covalent compounds. Identify and describe the different types of chemical bonding. Being able to order atoms and ions based on their periodic properties Being able to write the electron configuration of atoms and ions.
E098513 Modelling, Making and Measuring	project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E015041 Informatics	lecture seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To design an algorithm solving a given problem, and to assess the complexity of this solution. To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	guided self-study lecture: plenary exercises seminar lecture	open book examination	Having acquired insight in the notions rank, image, kernel, invertability, and determinant of a linear transform. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces. Having acquired insight in the notions vector space, linear dependence and independence, basis and dimension. Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired insight in the mathematical, physical and geometric meaning of eigenvalues and eigenvectors.
E090320 Electrical Circuits and Networks	lecture seminar: coached exercises	written examination	Draw amplitude and phase Bode diagrams for transfer functions and determine the poles and zeros. Analyze basic electrical circuits containing diodes, bipolar transistors and MOSFETs. Determine the balance of active and reactive electrical power in a three-phase electrical network. Analyze linear circuits with resistors, (coupled) inductors and capacitors in dc, in the periodic regime and during transients.
E040420 Mechanics of Materials	seminar: coached exercises	written examination open book examination	To be familiar with the applications of linear elasticity theory. To identify mechanical test methods. Applications of the problem solving methods in elasticity theory. To identify linear and non-linear behaviour. Knowledge of the main techniques for damage control and diagnostics. To be familiar with the basic notions of linear elasticity theory.
E020220 Physics II	demonstration lecture	written examination participation	To be able to solve physics problems by applying these laws and concepts. To understand the physical laws and concepts of the covered chapters.

E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)
E034110 Computer Architecture	lecture seminar: coached exercises		To know the contemporary challenges in computer architecture To have knowledge about the elementary building blocks of computers
E012110 Communication Theory	guided self-study online seminar: coached exercises online lecture: response lecture online lecture online group work lecture: response lecture seminar: coached exercises lecture group work	open book examination assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	lecture	written examination	Being familiar with the basic concepts of database systems and databases.
E017610 Software Engineering	lecture seminar: practical PC room classes	written examination	To know design patterns and apply them where appropriate. To realize a Java program, according to UML specification (including a graphical user interface). To design unit tests, and to realise them in the JUnit framework. To know the concepts of software components and to master the Java Beans component model (including dynamic class loading and runtime type identification). To master object serialisation (including socket programming). To build an architecture and a design for an application of limited complexity, using an UML-based methodology. To master the programming primitives related to multi-threading and to realise a multi-threaded program in Java.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099010 Cross-Course Project	project	oral examination report	Linking several knowledge domains. Keeping a global sight over the project.
E016020 Automata Theory	lecture seminar	open book examination	To understand and to apply properties of formal languages such as the theorem of Kleene, the pumping lemma and the result of operations on formal languages To understand and to apply properties of finite-state machines and Turing machines w.r.t. the realization of behavior functions and computability To creatively design state machines, Turing machines and pushdown automata with a given behavior To understand, to develop and to analyse Petri net models To understand and to apply methods to specify the syntax of formal languages
E017210 Computer Programming	group work seminar: practical PC room classes project lecture	open book examination report skills test	be able to apply datastructures and algorithms in practical programming exercises be able to work together in a team with other students to realize a programming assignment have a good overview of the various paradigms for computer programming have an insight in available platforms (and their pros and cons) for programming of software projects
E003110 Applied Probability	lecture seminar	open book examination	To determine distributions of (functions of) random variables To calculate and to interpret characteristics of random processes and stochastic signals To analyse the time-dependent and limiting behavior of random processes To understand and to apply the properties of random processes such as birth-death processes, Poisson processes, renewal processes and Markov chains To calculate and to interpret characteristics of random variables as moments and entropies
E001470 Discrete Mathematics II	lecture seminar: coached exercises	open book examination	To construct and connect the different representations of finite fields and to understand the specific properties of finite fields Recognize and solve simple matching problems Solve combinatorial problems To transform relations between sequences of numbers to generating functions and vice versa
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.

E031110	Digital Electronics	practicum	participation report skills test	To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits. To be able to specify Boolean functions and synchronous finite state machines and interpret such specifications. To be familiar with some basic algorithms for combinational and sequential logic design and to be able to apply them to small examples. To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001132 Mathematical Analysis I	lecture lecture: plenary exercises seminar	written examination	Being able to assess the convergence of numerical series and series of functions. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E001460 Discrete Mathematics I	practicum	written examination	Distinguishing and applying fundamental algebraic and discrete structures. Being fluent in graph algorithms and applying them to real problem situations. Deploying deductively correct reasonings in an independent way. Evaluating logical reasonings with respect to correctness / identifying errors. Deploying mathematical reasoning and proof argumentation. Using basic concepts from set theory, group theory, combinatorics and graph theory.
E098513 Modelling, Making and Measuring	project	participation report	Use of software tools to make simulations and diagrams
E015041 Informatics	lecture seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E000662 Geometry and Linear Algebra	guided self-study lecture: plenary exercises seminar lecture	written examination	Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces.
E012110 Communication Theory	group work online seminar: coached exercises online group work seminar: coached exercises		To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E017210 Computer Programming	group work project	open book examination report skills test	be able to apply datastructures and algorithms in practical programming exercises be able to work together in a team with other students to realize a programming assignment have an insight in available platforms (and their pros and cons) for programming of software projects
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems

Course	Teaching methods	Evaluation methods	Course learning outcome
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E015041 Informatics	seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E090320 Electrical Circuits and Networks	lecture online seminar seminar: coached exercises		Analyze basic electrical circuits containing diodes, bipolar transistors and MOSFETs.
E034110 Computer Architecture	lecture seminar: coached exercises practicum	written examination with open questions report assignment open book examination	To have knowledge about the elementary building blocks of computers To understand machine language programs To understand the operation of a pipelined architecture To understand the operation of the memory hierarchy
E018110 Databases	lecture ** seminar: practical PC room classes	written examination	Understanding how database systems work. Designing, setting up and maintaining databases. Manipulating and querying databases. Being familiar with the basic concepts of database systems and databases.
E017210 Computer Programming	lecture	report	have an insight in available platforms (and their pros and cons) for programming of software projects have a good overview of the various paradigms for computer programming
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E019010 Operating Systems	** guided self-study seminar: coached exercises lecture	written examination with open questions report assignment	To know the history of operating systems To understand input/output To understand memory management To know the most important system management processes To understand virtualization
E031110 Digital Electronics	practicum		To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits.

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E003043 Probability and Statistics	seminar: coached exercises	written examination with multiple choice questions open book examination	To calculate probabilities of events and expectations of random variables To perform a linear regression and to interpret its results To understand and to apply methods for hypothesis testing To understand and to apply methods for (parameter) estimation To interpret and to judge the results of statistical sampling, and to represent them in an appropriate form To identify an appropriate probabilistic model for the analysis of an event or experiment
E015041 Informatics	lecture seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E034110 Computer Architecture	lecture seminar: coached exercises practicum	written examination with open questions report assignment open book examination	To have knowledge about the elementary building blocks of computers To understand machine language programs
E018110 Databases	lecture ** seminar: coached exercises	written examination	Understanding how object technology and API's can be used. Designing, setting up and maintaining databases. Being familiar with the basic concepts of database systems and databases.
E017610 Software Engineering	lecture seminar: practical PC room classes	written examination assignment	To master the programming primitives related to multi-threading and to realise a multi-threaded program in Java. To realize a Java program, according to UML specification (including a graphical user interface). To know the concepts of software components and to master the Java Beans component model (including dynamic class loading and runtime type identification). To master object serialisation (including socket programming).
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099010 Cross-Course Project	project	report	Performing project work efficiently in a group. Approach project work methodically.
E017210 Computer Programming	group work seminar: practical PC room classes project lecture	open book examination report skills test	master the programming languages C and C++ be able to work together in a team with other students to realize a programming assignment have a good overview of the various paradigms for computer programming be able to apply datastructures and algorithms in practical programming exercises
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E031110 Digital Electronics	practicum	participation report skills test	To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
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E018110 Databases	lecture ** seminar: practical PC room classes	written examination	Understanding how object technology and API's can be used. Being familiar with the basic concepts of database systems and databases. Understanding how database systems work.
E019130 Multimedia Techniques	lecture seminar: practical PC room classes	oral examination assignment	To know multimedia platforms and standards, and being able to compare them.
E017210 Computer Programming	lecture		have an insight in available platforms (and their pros and cons) for programming of software projects have a good overview of the various paradigms for computer programming
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E008620 Communication Networks	lecture lecture: plenary exercises practicum	written examination report open book examination	Use and development of application layer protocols Set-up of IP networks Design and set-up of a secure network (layer 2 up to layer 5) Configuration of ethernet local area networks
E019010 Operating Systems	** guided self-study practicum lecture		To know the history of operating systems To understand input/output To understand memory management To know the most important system management processes To have insight in process management To understand virtualization

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E090320 Electrical Circuits and Networks	lecture seminar: coached exercises	written examination	Analyze basic electrical circuits containing diodes, bipolar transistors and MOSFETs.
E012110 Communication Theory	guided self-study online seminar: coached exercises online lecture: response lecture online lecture online group work lecture: response lecture seminar: coached exercises lecture group work	open book examination assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	lecture ** seminar: practical PC room classes ** seminar: coached exercises	written examination	Understanding how object technology and API's can be used. Designing, setting up and maintaining databases.
E017610 Software Engineering	lecture	written examination assignment	To know design patterns and apply them where appropriate. To realize a Java program, according to UML specification (including a graphical user interface). To build an architecture and a design for an application of limited complexity, using an UML-based methodology.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E016020 Automata Theory	lecture seminar	open book examination	To understand and to apply properties of formal languages such as the theorem of Kleene, the pumping lemma and the result of operations on formal languages To understand and to apply properties of finite-state machines and Turing machines w.r.t. the realization of behavior functions and computability To creatively design state machines, Turing machines and pushdown automata with a given behavior To understand, to develop and to analyse Petri net models To understand and to apply methods to specify the syntax of formal languages
E017210 Computer Programming	group work project lecture	skills test report	be able to apply datastructures and algorithms in practical programming exercises be able to work together in a team with other students to realize a programming assignment have a good overview of the various paradigms for computer programming have an insight in available platforms (and their pros and cons) for programming of software projects
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E008620 Communication Networks	lecture lecture: plenary exercises practicum	written examination report open book examination	Understand how to build a network, applications versus application layer protocols, reliability, flow and congestion control, routing en switching, network hierarchy, medium access control, public versus symmetric encryption, authentication, encryption, integrity, architecture. Being able to work with the following concepts: protocol reference model; application layer protocols HTTP, SMTP, POP, ...; state diagram, message sequence chart, retransmission protocols, routing protocols (IGP and EGP), sub networks, addressing, MAC protocols, hub versus switch, security protocols.
E031110 Digital Electronics	practicum	participation report skills test	To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits. To be able to specify Boolean functions and synchronous finite state machines and interpret such specifications. To be familiar with some basic algorithms for combinational and sequential logic design and to be able to apply them to small examples. To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E098513 Modelling, Making and Measuring	project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E015041 Informatics	seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E034110 Computer Architecture	lecture seminar: coached exercises practicum		To understand machine language programs
E018110 Databases	** seminar: practical PC room classes	written examination	Manipulating and querying databases.
E017610 Software Engineering	seminar: practical PC room classes	written examination skills test	To master the programming primitives related to multi-threading and to realise a multi-threaded program in Java. To realize a Java program, according to UML specification (including a graphical user interface). To know the concepts of software components and to master the Java Beans component model (including dynamic class loading and runtime type identification). To master object serialisation (including socket programming).
E099010 Cross-Course Project	project	report	Linking several knowledge domains. Approach project work methodically.
E017210 Computer Programming	group work project	open book examination report	master the programming languages C and C++ be able to work together in a team with other students to realize a programming assignment be able to apply datastructures and algorithms in practical programming exercises
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	lecture: plenary exercises seminar: coached exercises	written examination	Being able to perform basic calculations quickly and efficiently by hand. To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To identify an appropriate probabilistic model for the analysis of an event or experiment
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E001132 Mathematical Analysis I	seminar	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E098513 Modelling, Making and Measuring	project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Use of software tools to make simulations and diagrams
E015041 Informatics	lecture seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To design an algorithm solving a given problem, and to assess the complexity of this solution. To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	seminar	written examination open book examination	Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces.
E090320 Electrical Circuits and Networks	seminar: coached exercises	written examination	Analyze linear circuits with resistors, (coupled) inductors and capacitors in dc, in the periodic regime and during transients.
E040420 Mechanics of Materials	seminar: coached exercises	open book examination	To be familiar with the applications of linear elasticity theory. Applications of the problem solving methods in elasticity theory.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)
E034110 Computer Architecture	lecture seminar: coached exercises practicum	written examination with open questions report assignment open book examination	To have knowledge about the elementary building blocks of computers To understand machine language programs To understand the operation of a pipelined architecture
E012110 Communication Theory	group work online seminar: coached exercises online lecture: response lecture online group work lecture: response lecture seminar: coached exercises	open book examination assignment participation	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.

E018110 Databases	lecture ** seminar: practical PC room classes ** seminar: coached exercises	written examination	Understanding how object technology and API's can be used. Designing, setting up and maintaining databases. Manipulating and querying databases. Understanding how database systems work.
E017610 Software Engineering	lecture seminar: practical PC room classes	written examination skills test assignment	To know design patterns and apply them where appropriate. To design unit tests, and to realise them in the JUnit framework. To build an architecture and a design for an application of limited complexity, using an UML-based methodology.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099010 Cross-Course Project	project	oral examination report	Being able to plan a project. Approach project work methodically. Keeping a global sight over the project. Linking several knowledge domains. Knowing how to use project management software.
E016020 Automata Theory	lecture seminar	open book examination	To understand and to apply properties of formal languages such as the theorem of Kleene, the pumping lemma and the result of operations on formal languages To understand and to apply properties of finite-state machines and Turing machines w.r.t. the realization of behavior functions and computability To creatively design state machines, Turing machines and pushdown automata with a given behavior To understand, to develop and to analyse Petri net models To understand and to apply methods to specify the syntax of formal languages
E017210 Computer Programming	group work seminar: practical PC room classes project lecture	open book examination report skills test	master the programming languages C and C++ be able to work together in a team with other students to realize a programming assignment have a good overview of the various paradigms for computer programming have an insight in available platforms (and their pros and cons) for programming of software projects be able to apply datastructures and algorithms in practical programming exercises
E003110 Applied Probability	lecture seminar	open book examination	To determine distributions of (functions of) random variables To calculate and to interpret characteristics of random processes and stochastic signals To analyse the time-dependent and limiting behavior of random processes To understand and to apply the properties of random processes such as birth-death processes, Poisson processes, renewal processes and Markov chains To calculate and to interpret characteristics of random variables as moments and entropies
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E019010 Operating Systems	** guided self-study seminar: coached exercises practicum lecture	written examination with open questions report assignment	To understand virtualization To correctly use synchronization primitives To understand input/output To understand memory management To know the most important system management processes To have insight in process management
E031110 Digital Electronics	practicum	participation report skills test	To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits. To be able to specify Boolean functions and synchronous finite state machines and interpret such specifications. To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To identify an appropriate probabilistic model for the analysis of an event or experiment
E020061 Physics I	demonstration lecture	written examination	To understand the physical laws and concepts of the covered chapters. To be able to solve problems by applying these laws and concepts.
E001132 Mathematical Analysis I	lecture lecture: plenary exercises seminar	written examination	To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems.
E001460 Discrete Mathematics I	guided self-study seminar: coached exercises practicum lecture	written examination open book examination	Distinguishing and applying fundamental algebraic and discrete structures. Being fluent in graph algorithms and applying them to real problem situations. Deploying deductively correct reasonings in an independent way. Evaluating logical reasonings with respect to correctness / identifying errors. Deploying mathematical reasoning and proof argumentation. Using basic concepts from set theory, group theory, combinatorics and graph theory.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	lecture lecture: plenary exercises seminar	written examination open book examination	Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them.
E090320 Electrical Circuits and Networks	lecture seminar: coached exercises	written examination	Draw amplitude and phase Bode diagrams for transfer functions and determine the poles and zeros. Analyze basic electrical circuits containing diodes, bipolar transistors and MOSFETs. Determine the balance of active and reactive electrical power in a three-phase electrical network. Analyze linear circuits with resistors, (coupled) inductors and capacitors in dc, in the periodic regime and during transients.
E020220 Physics II	demonstration lecture	written examination participation	To be able to solve physics problems by applying these laws and concepts. To understand the physical laws and concepts of the covered chapters.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)
E076040 Sustainable Business Operations	lecture	written examination with open questions written examination with multiple choice questions	Understand the technique of financial balance sheet reading and be able to apply it practically in simple accounting exercises
E012110 Communication Theory	lecture online lecture		To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	** seminar: coached exercises ** seminar: practical PC room classes	written examination	Designing, setting up and maintaining databases.
E017610 Software Engineering	lecture	written examination assignment	To know design patterns and apply them where appropriate. To realize a Java program, according to UML specification (including a graphical user interface). To build an architecture and a design for an application of limited complexity, using an UML-based methodology.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems

E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E031110 Digital Electronics	practicum	participation report skills test	To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits. To be able to specify Boolean functions and synchronous finite state machines and interpret such specifications. To be familiar with some basic algorithms for combinational and sequential logic design and to be able to apply them to small examples. To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E070080 Chemical Thermodynamics	guided self-study seminar: coached exercises lecture	written examination open book examination	Application of the laws of thermodynamics on chemical systems. Calculation of the solubility of ionic compounds in aqueous solutions. Calculation of the pH of aqueous solutions. Understand and apply chemical equilibrium.
E003043 Probability and Statistics	lecture		To calculate probabilities of events and expectations of random variables
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E070070 Chemistry: the Structure of Matter	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform stoichiometric calculations. Identify and describe the different types of intermolecular interactions. Being able to determine the molecular geometry of covalent compounds. Identify and describe the different types of chemical bonding. Being able to order atoms and ions based on their periodic properties Being able to write the electron configuration of atoms and ions.
E098513 Modelling, Making and Measuring	project	report	Writing reports Oral presentation
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E012110 Communication Theory	group work online seminar: coached exercises online lecture: response lecture online group work lecture: response lecture seminar: coached exercises	open book examination assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	** seminar: coached exercises	written examination	Designing, setting up and maintaining databases.
E099010 Cross-Course Project	project	oral examination report	Being able to capture the essence of the project work in a short report. Being able to present the work clearly to fellow students.
E017210 Computer Programming	group work seminar: practical PC room classes project lecture	open book examination report	master the programming languages C and C++ be able to work together in a team with other students to realize a programming assignment have an insight in available platforms (and their pros and cons) for programming of software projects be able to apply datastructures and algorithms in practical programming exercises
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E008620 Communication Networks	practicum lecture: plenary exercises	written examination report open book examination	Use and development of application layer protocols Set-up of IP networks Have critical attitude during the design and evaluation of communication networks, based on a thorough understanding of the technical issues. Design and set-up of a secure network (layer 2 up to layer 5) Configuration of ethernet local area networks
E019010 Operating Systems	** guided self-study seminar: coached exercises practicum lecture	written examination with open questions report assignment	To know the most important system management processes To correctly use synchronization primitives

E031110 Digital Electronics	practicum	participation report skills test	To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits. To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	seminar: coached exercises	written examination	To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors. Being able to formulate correctly and with mathematical precision. Being able to make a correct reasoning and to write it down in a structured way.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To perform a linear regression and to interpret its results To understand and to apply methods for hypothesis testing To understand and to apply methods for (parameter) estimation To interpret and to judge the results of statistical sampling, and to represent them in an appropriate form To identify an appropriate probabilistic model for the analysis of an event or experiment To calculate probabilities of events and expectations of random variables
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E001132 Mathematical Analysis I	guided self-study	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and integrability. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E015041 Informatics	guided self-study seminar: practical PC room classes lecture	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To design an algorithm solving a given problem, and to assess the complexity of this solution. To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	guided self-study	written examination open book examination	Having acquired skills in the manipulation of vectors.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)
E076040 Sustainable Business Operations	lecture	written examination with open questions written examination with multiple choice questions	Critical, creative thinking and scientific reasoning Be able to think carefully about social, scientific and ethical problems and possible solutions to these problems
E034110 Computer Architecture	lecture seminar: coached exercises practicum	written examination with open questions report assignment open book examination	To know the contemporary challenges in computer architecture To understand machine language programs To understand the operation of a pipelined architecture To understand the operation of the memory hierarchy To have knowledge about the elementary building blocks of computers
E012110 Communication Theory	guided self-study online seminar: coached exercises online lecture: response lecture online lecture online group work lecture: response lecture seminar: coached exercises lecture group work	participation	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.

E017610 Software Engineering	lecture seminar: practical PC room classes	written examination skills test assignment	To know design patterns and apply them where appropriate. To realize a Java program, according to UML specification (including a graphical user interface). To design unit tests, and to realise them in the JUnit framework. To know the concepts of software components and to master the Java Beans component model (including dynamic class loading and runtime type identification). To master object serialisation (including socket programming). To build an architecture and a design for an application of limited complexity, using an UML-based methodology. To master the programming primitives related to multi-threading and to realise a multi-threaded program in Java.
E099010 Cross-Course Project	project	report	Being able to plan a project. Approach project work methodically. Finding a clear structure in project tasks. Keeping a global sight over the project. Linking several knowledge domains. Being able to distribute group work evenly between the group members.
E016020 Automata Theory	seminar	open book examination	To understand and to apply properties of formal languages such as the theorem of Kleene, the pumping lemma and the result of operations on formal languages To understand and to apply properties of finite-state machines and Turing machines w.r.t. the realization of behavior functions and computability To creatively design state machines, Turing machines and pushdown automata with a given behavior To understand, to develop and to analyse Petri net models To understand and to apply methods to specify the syntax of formal languages
E017210 Computer Programming	group work project	report	master the programming languages C and C++ have an insight in available platforms (and their pros and cons) for programming of software projects be able to apply datastructures and algorithms in practical programming exercises
E003110 Applied Probability	seminar	open book examination	To determine distributions of (functions of) random variables To calculate and to interpret characteristics of random processes and stochastic signals To analyse the time-dependent and limiting behavior of random processes To understand and to apply the properties of random processes such as birth-death processes, Poisson processes, renewal processes and Markov chains To calculate and to interpret characteristics of random variables as moments and entropies
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	lecture seminar: coached exercises lecture: plenary exercises	written examination	Being able to make a correct reasoning and to write it down in a structured way.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To identify an appropriate probabilistic model for the analysis of an event or experiment To calculate probabilities of events and expectations of random variables
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E020061 Physics I	demonstration lecture		To understand the physical laws and concepts of the covered chapters. To be able to solve problems by applying these laws and concepts.
E001132 Mathematical Analysis I	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and integrability. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E001460 Discrete Mathematics I	guided self-study seminar: coached exercises practicum lecture	written examination open book examination	Distinguishing and applying fundamental algebraic and discrete structures. Being fluent in graph algorithms and applying them to real problem situations. Deploying deductively correct reasonings in an independent way. Evaluating logical reasonings with respect to correctness / identifying errors. Deploying mathematical reasoning and proof argumentation. Using basic concepts from set theory, group theory, combinatorics and graph theory.
E098513 Modelling, Making and Measuring	project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Use of software tools to make simulations and diagrams
E015041 Informatics	lecture seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Having acquired insight in the notions rank, image, kernel, invertability, and determinant of a linear transform. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces. Having acquired insight in the notions vector space, linear dependence and independence, basis and dimension. Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired insight in the mathematical, physical and geometric meaning of eigenvalues and eigenvectors.
E090320 Electrical Circuits and Networks	seminar: coached exercises	written examination	Draw amplitude and phase Bode diagrams for transfer functions and determine the poles and zeros. Analyze linear circuits with resistors, (coupled) inductors and capacitors in dc, in the periodic regime and during transients.
E040420 Mechanics of Materials	seminar: coached exercises	open book examination	To be familiar with the applications of linear elasticity theory. Applications of the problem solving methods in elasticity theory.
E020220 Physics II	demonstration lecture	written examination participation	To be able to solve physics problems by applying these laws and concepts. To understand the physical laws and concepts of the covered chapters.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.

E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)
E034110 Computer Architecture	lecture seminar: coached exercises practicum		To have knowledge about the elementary building blocks of computers To understand machine language programs To understand the operation of a pipelined architecture To understand the operation of the memory hierarchy
E012110 Communication Theory	guided self-study online seminar: coached exercises online lecture: response lecture online lecture online group work lecture: response lecture seminar: coached exercises lecture group work	open book examination assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	** seminar: coached exercises ** seminar: practical PC room classes	written examination	Understanding how object technology and API's can be used. Designing, setting up and maintaining databases. Manipulating and querying databases.
E017610 Software Engineering	seminar: practical PC room classes	written examination assignment	To know design patterns and apply them where appropriate. To build an architecture and a design for an application of limited complexity, using an UML-based methodology.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099010 Cross-Course Project	project	oral examination report	Knowing how to use project management software. Approach project work methodically. Keeping a global sight over the project. Being able to change the planning and group dynamics when needed. Being able to distribute group work evenly between the group members.
E016020 Automata Theory	lecture seminar	open book examination	To understand and to apply properties of formal languages such as the theorem of Kleene, the pumping lemma and the result of operations on formal languages To understand and to apply properties of finite-state machines and Turing machines w.r.t. the realization of behavior functions and computability To creatively design state machines, Turing machines and pushdown automata with a given behavior To understand, to develop and to analyse Petri net models To understand and to apply methods to specify the syntax of formal languages
E017210 Computer Programming	group work seminar: practical PC room classes project lecture	open book examination report skills test	master the programming languages C and C++ be able to work together in a team with other students to realize a programming assignment have an insight in available platforms (and their pros and cons) for programming of software projects be able to apply datastructures and algorithms in practical programming exercises
E003110 Applied Probability	lecture seminar	open book examination	To determine distributions of (functions of) random variables To calculate and to interpret characteristics of random processes and stochastic signals To analyse the time-dependent and limiting behavior of random processes To understand and to apply the properties of random processes such as birth-death processes, Poisson processes, renewal processes and Markov chains To calculate and to interpret characteristics of random variables as moments and entropies
E001470 Discrete Mathematics II	lecture seminar: coached exercises	open book examination	To have insight in algebraic structures and their properties Recognize and solve simple matching problems Solve combinatorial problems To transform relations between sequences of numbers to generating functions and vice versa To construct and connect the different representations of finite fields and to understand the specific properties of finite fields To be familiar with polynomials and rational expressions with coefficients in a (finite) field and with real coefficients
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E008620 Communication Networks	practicum	written examination report open book examination	Understand how to build a network, applications versus application layer protocols, reliability, flow and congestion control, routing en switching, network hierarchy, medium access control, public versus symmetric encryption, authentication, encryption, integrity, architecture. Being able to work with the following concepts: protocol reference model; application layer protocols HTTP, SMTP, POP, ...; state diagram, message sequence chart, retransmission protocols, routing protocols (IGP and EGP), sub networks, addressing, MAC protocols, hub versus switch, security protocols.
E019010 Operating Systems	** guided self-study seminar: coached exercises practicum lecture	written examination with open questions report assignment	To understand virtualization To correctly use synchronization primitives To understand input/output To understand memory management To have insight in process management

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	lecture seminar: coached exercises lecture: plenary exercises	written examination	Being able to formulate correctly and with mathematical precision.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To perform a linear regression and to interpret its results To understand and to apply methods for hypothesis testing To understand and to apply methods for (parameter) estimation To interpret and to judge the results of statistical sampling, and to represent them in an appropriate form To identify an appropriate probabilistic model for the analysis of an event or experiment To calculate probabilities of events and expectations of random variables
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E001132 Mathematical Analysis I	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and integrability. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E001460 Discrete Mathematics I	guided self-study seminar: coached exercises practicum lecture	written examination open book examination	Distinguishing and applying fundamental algebraic and discrete structures. Being fluent in graph algorithms and applying them to real problem situations. Deploying deductively correct reasonings in an independent way. Evaluating logical reasonings with respect to correctness / identifying errors. Deploying mathematical reasoning and proof argumentation. Using basic concepts from set theory, group theory, combinatorics and graph theory.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Having acquired insight in the notions rank, image, kernel, invertability, and determinant of a linear transform. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces. Having acquired insight in the notions vector space, linear dependence and independence, basis and dimension. Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired insight in the mathematical, physical and geometric meaning of eigenvalues and eigenvectors.
E090320 Electrical Circuits and Networks	seminar: coached exercises	written examination	Analyze linear circuits with resistors, (coupled) inductors and capacitors in dc, in the periodic regime and during transients.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)

E034110 Computer Architecture	lecture seminar: coached exercises practicum		To understand machine language programs
E012110 Communication Theory	group work online group work	assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	lecture ** seminar: practical PC room classes ** seminar: coached exercises	written examination	Understanding how object technology and API's can be used. Designing, setting up and maintaining databases. Manipulating and querying databases.
E017610 Software Engineering	lecture	written examination assignment	To know design patterns and apply them where appropriate. To build an architecture and a design for an application of limited complexity, using an UML-based methodology.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099010 Cross-Course Project	project	report	Being able to change the planning and group dynamics when needed.
E016020 Automata Theory	lecture seminar	open book examination	To understand and to apply properties of formal languages such as the theorem of Kleene, the pumping lemma and the result of operations on formal languages To understand and to apply properties of finite-state machines and Turing machines w.r.t. the realization of behavior functions and computability To creatively design state machines, Turing machines and pushdown automata with a given behavior To understand, to develop and to analyse Petri net models To understand and to apply methods to specify the syntax of formal languages
E017210 Computer Programming	group work seminar: practical PC room classes project lecture	open book examination report skills test	master the programming languages C and C++ be able to work together in a team with other students to realize a programming assignment have a good overview of the various paradigms for computer programming have an insight in available platforms (and their pros and cons) for programming of software projects be able to apply datastructures and algorithms in practical programming exercises
E003110 Applied Probability	lecture seminar	open book examination	To determine distributions of (functions of) random variables To calculate and to interpret characteristics of random processes and stochastic signals To analyse the time-dependent and limiting behavior of random processes To understand and to apply the properties of random processes such as birth-death processes, Poisson processes, renewal processes and Markov chains To calculate and to interpret characteristics of random variables as moments and entropies
E001470 Discrete Mathematics II	lecture seminar: coached exercises	open book examination	To have insight in algebraic structures and their properties Recognize and solve simple matching problems Solve combinatorial problems To transform relations between sequences of numbers to generating functions and vice versa To construct and connect the different representations of finite fields and to understand the specific properties of finite fields To be familiar with polynomials and rational expressions with coefficients in a (finite) field and with real coefficients
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E008620 Communication Networks	practicum	open book examination report	Have critical attitude during the design and evaluation of communication networks, based on a thorough understanding of the technical issues.
E019010 Operating Systems	** guided self-study seminar: coached exercises practicum lecture	written examination with open questions report assignment	To understand virtualization To correctly use synchronization primitives To understand input/output To understand memory management To have insight in process management

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E070080 Chemical Thermodynamics	guided self-study seminar: coached exercises lecture	written examination open book examination	Application of the laws of thermodynamics on chemical systems. Calculation of the solubility of ionic compounds in aqueous solutions. Calculation of the pH of aqueous solutions. Understand and apply chemical equilibrium.
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E020061 Physics I	demonstration lecture		To understand the physical laws and concepts of the covered chapters. To be able to solve problems by applying these laws and concepts.
E070070 Chemistry: the Structure of Matter	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform stoichiometric calculations. Identify and describe the different types of intermolecular interactions. Being able to determine the molecular geometry of covalent compounds. Identify and describe the different types of chemical bonding. Being able to order atoms and ions based on their periodic properties Being able to write the electron configuration of atoms and ions.
E098513 Modelling, Making and Measuring	project	participation report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Use of software tools to make simulations and diagrams
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E020220 Physics II	demonstration lecture	written examination participation	To be able to solve physics problems by applying these laws and concepts. To understand the physical laws and concepts of the covered chapters.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)
E076040 Sustainable Business Operations	lecture	written examination with open questions written examination with multiple choice questions	Understanding sustainability aspects in an economic context
E034110 Computer Architecture	lecture		To know the contemporary challenges in computer architecture
E018110 Databases	lecture	written examination	Understanding how database systems work. Being familiar with the basic concepts of database systems and databases.
E017610 Software Engineering	seminar: practical PC room classes	written examination assignment	To know design patterns and apply them where appropriate. To know the concepts of software components and to master the Java Beans component model (including dynamic class loading and runtime type identification). To master object serialisation (including socket programming). To master the programming primitives related to multi-threading and to realise a multi-threaded program in Java.
E099010 Cross-Course Project	project	oral examination report	Linking several knowledge domains. Approach project work methodically.
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	To identify systems and signals; to describe them in continuous time and discrete time. To be able to execute the Laplace transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To be able to execute the Z-transform, to calculate its inverse, and to apply when studying systems and signals. (exclusively for the 6 credit points course.) To have understood the sampling theorem and its applications. To have gained insight in the various Fourier transforms. To have gained insight in the impulse response , the frequency response and the transfer function as an alternative description of a linear system, as well as in their mutual relationships. To have gained insight in Fourier series as a basis for the decription of signals and as a basis for transforming signals. To describe linear systems by means of the state model. (exclusively for the 6 credit points course.)

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	lecture seminar: coached exercises lecture: plenary exercises	written examination	To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors. Being able to formulate correctly and with mathematical precision. Being able to make a correct reasoning and to write it down in a structured way.
E070080 Chemical Thermodynamics	guided self-study seminar: coached exercises lecture	written examination open book examination	Application of the laws of thermodynamics on chemical systems. Calculation of the solubility of ionic compounds in aqueous solutions. Calculation of the pH of aqueous solutions. Understand and apply chemical equilibrium.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To perform a linear regression and to interpret its results To understand and to apply methods for hypothesis testing To understand and to apply methods for (parameter) estimation To interpret and to judge the results of statistical sampling, and to represent them in an appropriate form To calculate probabilities of events and expectations of random variables
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	lecture project	participation assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E020061 Physics I	demonstration lecture		To understand the physical laws and concepts of the covered chapters. To be able to solve problems by applying these laws and concepts.
E001132 Mathematical Analysis I	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and integrability. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E070070 Chemistry: the Structure of Matter	guided self-study seminar: coached exercises lecture		Being able to perform stoichiometric calculations. Being able to determine the molecular geometry of covalent compounds. Identify and describe the different types of chemical bonding. Being able to order atoms and ions based on their periodic properties Being able to write the electron configuration of atoms and ions.
E098513 Modelling, Making and Measuring	project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Oral presentation Writing reports
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	guided self-study lecture: plenary exercises seminar lecture	written examination open book examination	Having acquired insight in the notions rank, image, kernel, invertability, and determinant of a linear transform. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces. Having acquired insight in the notions vector space, linear dependence and independence, basis and dimension. Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired insight in the mathematical, physical and geometric meaning of eigenvalues and eigenvectors.
E020220 Physics II	demonstration lecture	written examination participation	To be able to solve physics problems by applying these laws and concepts. To understand the physical laws and concepts of the covered chapters.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
E034110 Computer Architecture	lecture seminar: coached exercises practicum	written examination with open questions report assignment open book examination	To know the contemporary challenges in computer architecture To understand machine language programs To understand the operation of a pipelined architecture To understand the operation of the memory hierarchy To have knowledge about the elementary building blocks of computers

E012110 Communication Theory	guided self-study online seminar: coached exercises online lecture online group work seminar: coached exercises lecture group work	open book examination assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	lecture ** seminar: coached exercises	written examination	Understanding how object technology and API's can be used. Designing, setting up and maintaining databases. Being familiar with the basic concepts of database systems and databases. Understanding how database systems work.
E099010 Cross-Course Project	project	oral examination report	Being able to capture the essence of the project work in a short report. Being able to present the work clearly to fellow students.
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E008620 Communication Networks	lecture	written examination	Being able to work with the following concepts: protocol reference model; application layer protocols HTTP, SMTP, POP, ...; state diagram, message sequence chart, retransmission protocols, routing protocols (IGP and EGP), sub networks, addressing, MAC protocols, hub versus switch, security protocols.
E019010 Operating Systems	** guided self-study seminar: coached exercises practicum lecture	written examination with open questions report assignment	To know the history of operating systems To correctly use synchronization primitives To understand input/output To understand memory management To know the most important system management processes To have insight in process management To understand virtualization

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E098513 Modelling, Making and Measuring	project	participation report	Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E012110 Communication Theory	group work online group work	assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E018110 Databases	** seminar: coached exercises ** seminar: practical PC room classes	written examination	Designing, setting up and maintaining databases.
E019130 Multimedia Techniques	seminar: practical PC room classes	assignment skills test	Being able to set up simple multimedia applications.
E099010 Cross-Course Project	project	oral examination report	Being able to plan a project. Approach project work methodically. Keeping a global sight over the project. Being able to change the planning and group dynamics when needed. Being able to distribute group work evenly between the group members. Performing project work efficiently in a group. Knowing how to use project management software.
E017210 Computer Programming	project	report	be able to work together in a team with other students to realize a programming assignment
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.

Course	Teaching methods	Evaluation methods	Course learning outcome
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E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E098513 Modelling, Making and Measuring	project	participation report	Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E034110 Computer Architecture	lecture seminar: coached exercises practicum		To have knowledge about the elementary building blocks of computers To understand machine language programs To understand the operation of a pipelined architecture To understand the operation of the memory hierarchy
E012110 Communication Theory	group work online group work		To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E017610 Software Engineering	seminar: practical PC room classes	assignment skills test	To build an architecture and a design for an application of limited complexity, using an UML-based methodology. To realize a Java program, according to UML specification (including a graphical user interface).
E019130 Multimedia Techniques	seminar: practical PC room classes	assignment	Being able to set up simple multimedia applications.
E099010 Cross-Course Project	project	oral examination report	Performing project work efficiently in a group. Being able to change the planning and group dynamics when needed. Being able to distribute group work evenly between the group members.
E017210 Computer Programming	group work project	report	be able to work together in a team with other students to realize a programming assignment
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture		Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E031110 Digital Electronics	practicum		To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

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E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E098512 Sustainability, Entrepreneurship and Ethics	lecture project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E098513 Modelling, Making and Measuring	lecture project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Oral presentation Writing reports
E012110 Communication Theory	group work online group work	assignment	To master the basic techniques for modulation and detection. To be aware of the limitations imposed by the transmission channel on the bit rate and the reliability of the link. To evaluate the link quality from eye patterm and scatter diagram. To determine the error probability and the bandwidth requirements of simple modulation systems. To carry out error detection and correction based on syndrome computation. To compute the compression ratio of simple source coding algorithms. To have insight in the operation of algorithms for source and channel coding. To compute the efficiency of simple retransmission protocols.
E017610 Software Engineering	seminar: practical PC room classes	assignment skills test	To build an architecture and a design for an application of limited complexity, using an UML-based methodology. To realize a Java program, according to UML specification (including a graphical user interface).
E019130 Multimedia Techniques	seminar: practical PC room classes	assignment skills test	To know and apply basic principles of image, video and audio processing. Being able to set up simple multimedia applications. To know and being able to apply basic sampling and quantization methods, especially in the context of digital-audio applications. To know and apply basic methods for the compression of still images and video.
E002021 Formal Systems Modelling for Software	lecture seminar: practical PC room classes seminar: coached exercises project	written examination with open questions report open book examination	Calculational reasoning in computer sciences Reasoning formally about temporal logics and temporal specification patterns Applying modelling methods to systems specifications and implementations in software Using a model checker (especially TLC) and interpreting the results Smoothly calculating formally with predicates and quantifiers Establishing and reasoning about formal system models in TLA+
E099010 Cross-Course Project	project	oral examination report	Being able to capture the essence of the project work in a short report. Being able to present the work clearly to fellow students.
E017210 Computer Programming	group work	report	be able to work together in a team with other students to realize a programming assignment
E099111 Engineering Project	group work online group work practicum lecture	oral examination report peer assessment assignment	Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E018310 Algorithms and Data Structures	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination assignment oral examination	Know the key data structures. Apply and implement data structures and algorithms, possibly using existing libraries. Apply the main Python/C++ libraries for algorithms and data structures. Critically assess new and existing software implementations in terms of their scalability and complexity. Select the most appropriate data structures and algorithms for a given problem, and provide motivation for the chosen structure/algorithm. Determine the complexity of algorithms. List the most important basic algorithms for engineering applications and understand the philosophy behind them.
E031110 Digital Electronics	practicum	report	To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation. To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits. To be able to specify Boolean functions and synchronous finite state machines and interpret such specifications. To be familiar with some basic algorithms for combinational and sequential logic design and to be able to apply them to small examples. To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Course	Teaching methods	Evaluation methods	Course learning outcome
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E066012 Materials Technology	seminar: practical PC room classes	written examination	To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties
E098512 Sustainability, Entrepreneurship and Ethics	lecture project	participation assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E076040 Sustainable Business Operations	lecture	written examination with open questions written examination with multiple choice questions	Critical, creative thinking and scientific reasoning Be able to think carefully about social, scientific and ethical problems and possible solutions to these problems
E018110 Databases	lecture ** seminar: practical PC room classes	written examination	Understanding how database systems work.
E017210 Computer Programming	project	report	be able to work together in a team with other students to realize a programming assignment
E099111 Engineering Project	group work online group work practicum lecture		Be acquainted with the architecture of a simple processor Be able to use softare development aids such as compilers, debuggers and software versioning control systems Be able to handle simple simulation software or measurement equipment such as emulators Be able to analyse simple problems and implement their solution on a microcontroller based platform Have some feeling for the real-time behavior of a simple architecture and its interactions with other system components such as memory and I/O Be acquainted with the way in which programs are represented and executed on simple computer systems
E019010 Operating Systems	** guided self-study practicum lecture	written examination with open questions	To know the most important system management processes To understand input/output

Course	Teaching methods	Evaluation methods	Course learning outcome
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E098512 Sustainability, Entrepreneurship and Ethics	lecture project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E076040 Sustainable Business Operations	lecture	written examination with open questions assignment written examination with multiple choice questions	Understand the technique of financial balance sheet reading and be able to apply it practically in simple accounting exercises Mastering the basic concepts of macroeconomics and microeconomy: law of supply and demand, markets (perfect competition, monopoly, oligopoly, game theory) Understanding the coherence between the different stakeholders of the company Being able to make a simple investment analysis and apply the concept of time value of money in all aspects of investment analysis Being able to make a complete costing for a product or a service Being able to distinguish between fixed, variable, direct and indirect costs Be able to analyze and assess the data of a company's balance sheet Understanding sustainability aspects in an economic context
E017210 Computer Programming	lecture		have an insight in available platforms (and their pros and cons) for programming of software projects have a good overview of the various paradigms for computer programming
E019010 Operating Systems	** guided self-study lecture	written examination with open questions	To know the history of operating systems To know the most important system management processes To understand virtualization