Competence coverage matrix

GHENT UNIVERSITY
Bachelor of Science in Engineering

Electrical Engineering

Academic year 2021-2022

Legend:
T=teaching methods
E=evaluation methods

Course columns

General Courses:
1. E001142 Basic Mathematics
2. E070080 Chemical Thermodynamics
3. E003043 Probability and Statistics
4. E066012 Materials Technology
5. E098512 Sustainability, Entrepreneurship and Ethics
6. E020061 Physics I
7. E001132 Mathematical Analysis I
8. E001460 Discrete Mathematics I
9. E070070 Chemistry, the Structure of Matter
10. E098513 Modelling, Making and Measuring
11. E015041 Informatics
12. E001222 Mathematical Analysis II
13. E000662 Geometry and Linear Algebra
14. E090320 Electrical Circuits and Networks
15. E040420 Mechanics of Materials
16. E020220 Physics II
17. E005020 Analysis of Systems and Signals
18. E001321 Mathematical Analysis III
19. E007120 Modelling and Control of Dynamic Systems
20. E076040 Sustainable Business Operations

Courses Related to the Main Subject:
21. E003110 Applied Probability
22. E030210 Analog Electronics
23. E030610 Photonics
24. E010010 Signal Processing
25. E028410 Fluid Dynamics and Heat Transfer in Electronics
26. E099020 Cross-Course Project
27. E030230 Design of Analog Circuits and Building Blocks
28. E017210 Computer Programming
29. E099121 Engineering Project
30. E065110 Materials in Electronics
31. E034110 Computer Architecture
32. E012110 Communication Theory
33. E900039 Applied Electromagnetism
34. E031110 Digital Electronics
35. E008620 Communication Networks

Competences (teaching T / evaluation E totals)

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 29**
- Employ the basic sciences and techniques (statistics, ICT, CAD) in a creative and purposeful way. — **T 15 / E 14**
- Analyse, design (based on well-defined technical specifications) and realise elementary circuits by means of the most common analogue and digital (opto-) electronic components. — **T 8 / E 8**
- Know and creatively apply physical models for the description of electric and thermal properties of materials and (opto-) electronic components, and for the design of elementary systems (based on well-defined technical specifications). — **T 7 / E 7**
- Analyse, design (based on detailed technical specifications) and realise simple algorithms for signal and data processing in information and communication systems. — **T 7 / E 7**
- Be familiar with the role of electromagnetic waves in (opto-) electronic systems and account for these wave phenomena when designing elementary systems. — **T 5 / E 5**
- Perform measurements on elementary systems that incorporate a hardware and/or software component, and draw conclusions about the system performance given the measurement outcomes. — **T 7 / E 7**

Scientific competences
- Research and process technical and scientific information in a purposeful way. — **T 12 / E 11**
- Employ standard models, methods and techniques in assignments. — **T 24 / E 24**
- Schematize and model phenomena, processes, and systems. — **T 20 / E 18**
- Justify decision-making processes on rational grounds. — **T 19 / E 18**

Intellectual competences
- Understand and structure learning experiences. — **T 20 / E 19**
- Think in a conceptual, analytical, system-oriented, problem-solving and synthesizing way at different levels of abstraction. — **T 28 / E 25**
- Show precision, perseverance and critical reflection. — **T 23 / E 21**
- Show scientific curiosity. — **T 18 / E 14**
- Justify further studies or professional opportunities on rational grounds. — **T 3 / E 1**

Competences in cooperation and communication
- Master scientific and discipline-specific technical terminology (also in English). — **T 23 / E 20**
- Carry out concrete assignments systematically. — **T 10 / E 10**
- Work as part of a team. — **T 12 / E 9**
- Report results verbally, in writing, and graphically. — **T 14 / E 14**

Societal competences
- Act in an ethical and social way. — **T 8 / E 8**
- Be aware of the business aspects of the engineering discipline. — **T 6 / E 4**

Course totals (W = teaching weight, E = evaluation)

Course	W	E
Basic Mathematics	6	6
Chemical Thermodynamics	4	4
Probability and Statistics	7	6
Materials Technology	12	10
Sustainability, Entrepreneurship and Ethics	12	12
Physics I	5	2
Mathematical Analysis I	8	8
Discrete Mathematics I	5	5
Chemistry, the Structure of Matter	4	3
Modelling, Making and Measuring	11	11
Informatics	6	6
Mathematical Analysis II	9	9
Geometry and Linear Algebra	8	8
Electrical Circuits and Networks	6	6
Mechanics of Materials	3	3
Physics II	5	5
Analysis of Systems and Signals	8	8
Mathematical Analysis III	8	8
Modelling and Control of Dynamic Systems	11	11
Sustainable Business Operations	5	5
Applied Probability	5	5
Analog Electronics	21	20
Photonics	18	18
Signal Processing	13	13
Fluid Dynamics and Heat Transfer in Electronics	2	2
Cross-Course Project	21	20
Design of Analog Circuits and Building Blocks	19	19
Computer Programming	14	13
Engineering Project	19	18
Materials in Electronics	5	6
Computer Architecture	11	5
Communication Theory	13	10
Applied Electromagnetism	3	3
Digital Electronics	8	7
Communication Networks	4	4

EBingwALG1.1 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.

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Competences in one/more scientific discipline(s)

*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*

Course	Teaching methods	Evaluation methods	Course learning outcome
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.

Code	Name	Teaching methods	Examination methods	Learning outcomes
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.)
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.
E007120	Modelling and Control of Dynamic Systems	lecture seminar: coached exercises	written examination	Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems. To implement modeling and control on small scale setups by using personal laptop To design of controllers based on the application of root-locus techniques and frequency-response techniques such as Bode, Nyquist. Being able to analyse feedback control systems using several stability criteria. To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback control systems. To have insight regarding the static and dynamic behaviour of systems and to apply this insight when designing feedback loops. To derive transfer-function models and state-space models of physical systems and comprehend linear and nonlinear behavior.
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
E030210	Analog Electronics	lecture seminar: coached exercises practicum	written examination open book examination	To analyse fundamental electronic circuits at several abstraction levels. Efficiently using models with a suitable abstraction level.
E030610	Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010	Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications
E099020	Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains
E030230	Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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
E099121	Engineering Project	group work	participation report job performance assessment skills test	set up a measurement protocol to validate the operation of electrical circuits awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...)
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.
E900039	Applied Electromagnetism	lecture seminar: coached exercises project	written examination report open book examination	To understand, calculate and determine voltage and current behaviour on transmission lines. To determine antenna characteristics and array factors. To be able to describe, understand and discuss wave propagation in free space and in waveguides. To solve a numerical problem and program it.

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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises	written examination	To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback control systems.
E030210 Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	group work	assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Understand the organization and execution of a project Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice Understand the relationships and interactions between knowledge domains
E030230 Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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
E099121 Engineering Project	group work	participation report job performance assessment skills test	Measuring static and dynamic characteristics of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit
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.
E900039 Applied Electromagnetism	project	report	To solve a numerical problem and program it.

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	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.
E030210 Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
E099121 Engineering Project	group work	participation report job performance assessment skills test	Measuring static and dynamic characteristics of electrical components awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit
E065110 Materials in Electronics	lecture seminar: coached exercises practicum	written examination report open book examination	To be aware of the "black-box" basic models for common components in electrical engineering (electric, electronic and magnetic components) with respect to the materials that are used in these components.
E034110 Computer Architecture	lecture practicum	written examination with open questions report assignment open book examination	To have knowledge about the elementary building blocks of computers To understand the operation of a pipelined architecture To understand the operation of the memory hierarchy
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*			
E030210 Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E028410 Fluid Dynamics and Heat Transfer in Electronics	lecture seminar	open book examination	Estimating the influence of thermal phenomena on electronic circuits. Analyzing and solving simple problems that combine different forms of heat transfer. Calculating radiative heat transfer between arbitrary structures. Mathematically modeling complex thermal conduction problems. Analytically solving simple thermal conduction problems. Simplifying thermal problems to a solvable form.
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
E099121 Engineering Project	group work	participation report job performance assessment skills test	Measuring static and dynamic characteristics of electrical components awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit
E065110 Materials in Electronics	lecture seminar: coached exercises practicum	written examination open book examination	To be aware of macroscopic material models relevant for materials used in electronics (metals, semiconductors, dielectrics and magnetic materials). To apply physical material models derived from physical miscroscopic material models.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E030210 Analog Electronics	practicum	skills test	To make basic measurements on electronic circuits and systems.
E010010 Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	skills test	Insight in the operation and properties of phase-locked systems. Insight in the tradeoffs in the design of phase-locked systems.
E017210 Computer Programming	group work 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
E099121 Engineering Project	group work	skills test report job performance assessment	Measuring static and dynamic characteristics of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits
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.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E030210 Analog Electronics	practicum	skills test	To make basic measurements on electronic circuits and systems.
E030610 Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	practicum	skills test	Basic measurements on phase-locked systems.
E900039 Applied Electromagnetism	lecture seminar: coached exercises	written examination open book examination	To understand, calculate and determine voltage and current behaviour on transmission lines. To determine antenna characteristics and array factors. To solve a numerical problem and program it.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E030210 Analog Electronics	practicum	skills test	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E010010 Signal Processing	lecture practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	practicum	skills test	Basic measurements on phase-locked systems.
E099121 Engineering Project	group work	participation report peer assessment job performance assessment skills test	Using electrical measurement equipment awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
E034110 Computer Architecture	lecture practicum	written examination with open questions report assignment open book examination	To understand machine language programs
E031110 Digital Electronics	practicum	participation 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 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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems. To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback control systems.
E030210 Analog Electronics	practicum seminar: coached exercises	skills test	Efficiently using models with a suitable abstraction level. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits.
E030610 Photonics	group work	oral examination assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	practicum	skills test	Basic measurements on phase-locked systems.
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
E099121 Engineering Project	group work	participation report peer assessment job performance assessment skills test	Measuring static and dynamic characteristics of electrical components awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit
E065110 Materials in Electronics	Studentenpresentatie	assignment	To be aware of macroscopic material models relevant for materials used in electronics (metals, semiconductors, dielectrics and magnetic materials). To be aware of the "black-box" basic models for common components in electrical engineering (electric, electronic and magnetic components) with respect to the materials that are used in these components.
E034110 Computer Architecture	lecture seminar: coached exercises practicum		To understand machine language programs

Course	Teaching methods	Evaluation methods	Course learning outcome
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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.
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.)
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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises practicum	report	Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems. To implement modeling and control on small scale setups by using personal laptop
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
E030210 Analog Electronics	practicum seminar: coached exercises	skills test	Efficiently using models with a suitable abstraction level. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits.

Code	Course	Teaching methods	Evaluation methods	Learning outcomes
E030610	Photonics	group work seminar: coached exercises practicum	open book examination assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E028410	Fluid Dynamics and Heat Transfer in Electronics	lecture seminar	open book examination	Estimating the influence of thermal phenomena on electronic circuits. Designing efficient cooling fins. Analyzing and solving simple problems that combine different forms of heat transfer. Calculating radiative heat transfer between arbitrary structures. Analytically calculating convection coefficients for simple structures. Mathematically modeling liquid and air flow. Mathematically modeling complex thermal conduction problems. Analytically solving simple thermal conduction problems. Simplifying thermal problems to a solvable form.
E099020	Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230	Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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
E099121	Engineering Project	group work	participation report peer assessment job performance assessment skills test	Measuring static and dynamic characteristics of electrical components awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit
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.
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.
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.)
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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems. To derive transfer-function models and state-space models of physical systems and comprehend linear and nonlinear behavior.
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
E030210 Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	Efficiently using models with a suitable abstraction level. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits.
E030610 Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays

Code	Course	Teaching methods	Assessment	Learning outcomes
E010010	Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020	Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230	Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
E099121	Engineering Project	group work	skills test report peer assessment job performance assessment	Using electrical measurement equipment awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
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.
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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises practicum	written examination report	To have insight regarding the static and dynamic behaviour of systems and to apply this insight when designing feedback loops. To implement modeling and control on small scale setups by using personal laptop To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback control systems.
E030210 Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	seminar: coached exercises	open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Present clearly the project progress, results and solutions to fellow students.
E030230 Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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

E099121 Engineering Project	group work	participation report peer assessment job performance assessment skills test	Using electrical measurement equipment awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
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.
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.
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

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.
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.)
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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems.
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
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
E030210 Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.

Code	Course	Teaching methods	Assessment	Objectives
E030610	Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E099020	Cross-Course Project	project	report	See the relation between theory and practice Present clearly the project progress, results and solutions to fellow students.
E030230	Design of Analog Circuits and Building Blocks	guided self-study seminar: coached exercises practicum lecture	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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
E099121	Engineering Project	group work	participation report peer assessment job performance assessment skills test	Using electrical measurement equipment awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
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.

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.
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.)

Code	Course	Teaching	Assessment	Objectives
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.
E007120	Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems.
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
E030210	Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610	Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E099020	Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice
E030230	Design of Analog Circuits and Building Blocks	lecture seminar: coached exercises practicum	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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
E099121	Engineering Project	group work	participation report peer assessment job performance assessment skills test	Using electrical measurement equipment awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
E065110	Materials in Electronics	lecture	written examination open book examination	To identify the use and the purpose of materials (metals, semiconductors, dielectric and magnetic materials) in specialized components used in electrical engineering.
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.
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.

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.
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.)
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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback control systems.

Code	Name	Teaching methods	Assessment	Learning outcomes
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
E030210	Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610	Photonics	group work seminar: coached exercises practicum lecture	written examination skills test assignment oral examination and open book examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010	Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020	Cross-Course Project	project	report	Understand the organization and execution of a project Show creativity, self-motivation and team spirit during the execution of the project See the relation between theory and practice Understand the relationships and interactions between knowledge domains
E030230	Design of Analog Circuits and Building Blocks	guided self-study seminar: coached exercises practicum lecture	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
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
E099121	Engineering Project	group work	participation report peer assessment job performance assessment skills test	Using electrical measurement equipment awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
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.
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.

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
E030210 Analog Electronics	lecture seminar: coached exercises practicum	skills test	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	group work	assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Understand the relationships and interactions between knowledge domains See the relation between theory and practice
E030230 Design of Analog Circuits and Building Blocks	guided self-study seminar: coached exercises practicum lecture	skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.

E099121	Engineering Project	group work		Using electrical measurement equipment
				The ability to work in group
				awareness of imperfections of electrical components
				Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...)
				set up a measurement protocol to validate the operation of electrical circuits
				Design a simple electrical circuit
				Measuring static and dynamic characteristics of electrical components
E065110	Materials in Electronics	practicum	report	To be aware of macroscopic material models relevant for materials used in electronics (metals, semiconductors, dielectrics and magnetic materials).
				To be aware of the "black-box" basic models for common components in electrical engineering (electric, electronic and magnetic components) with respect
				to the materials that are used in these components.
E034110	Computer Architecture	lecture		To know the contemporary challenges in computer architecture

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.)
E030210 Analog Electronics	lecture seminar: coached exercises practicum		To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.

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. 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. 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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain mathematical models of physical dynamic systems. To design of controllers based on the application of root-locus techniques and frequency-response techniques such as Bode, Nyquist.

E030210	Analog Electronics	lecture seminar: coached exercises practicum	written examination skills test open book examination	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610	Photonics	group work seminar: coached exercises practicum lecture	assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010	Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020	Cross-Course Project	project	report	Present clearly the project progress, results and solutions to fellow students.
E030230	Design of Analog Circuits and Building Blocks	guided self-study seminar: coached exercises practicum lecture	written examination skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
E099121	Engineering Project	group work	job performance assessment report	Using electrical measurement equipment The ability to work in group awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
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 pattern 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.
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.

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.
E030210 Analog Electronics	practicum	skills test	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	group work	assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	practicum seminar: coached exercises	report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Apply basic concepts of project management Show creativity, self-motivation and team spirit during the execution of the project Perform project work efficiently in a group. Understand the organization and execution of a project
E030230 Design of Analog Circuits and Building Blocks	practicum	skills test	Insight in the operation and properties of phase-locked systems. Basic measurements on phase-locked systems. Insight in the tradeoffs in the design of switched-capacitor circuits. Analysis of switched-capacitor circuits. Analysis and design of oscillator circuits. Insight in the tradeoffs in the design of phase-locked systems.
E017210 Computer Programming	project	report	be able to work together in a team with other students to realize a programming assignment
E099121 Engineering Project	group work	participation report peer assessment job performance assessment	Measuring static and dynamic characteristics of electrical components The ability to work in group awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit
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 pattern 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.

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.
E030210 Analog Electronics	practicum	skills test	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	group work	assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	practicum seminar: coached exercises	report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Apply basic concepts of project management Show creativity, self-motivation and team spirit during the execution of the project Perform project work efficiently in a group. Understand the organization and execution of a project
E030230 Design of Analog Circuits and Building Blocks	practicum	skills test	Basic measurements on phase-locked systems.
E017210 Computer Programming	group work project	report	be able to work together in a team with other students to realize a programming assignment
E099121 Engineering Project	group work	job performance assessment report peer assessment	The ability to work in group
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 pattern 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.
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.

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	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
E007120 Modelling and Control of Dynamic Systems	practicum	report	To implement modeling and control on small scale setups by using personal laptop
E030210 Analog Electronics	practicum	skills test	To have insight in the operation and properties of basic analog electronic circuits. To make basic measurements on electronic circuits and systems. To have insight in the tradeoffs in the design of simple analog electronic circuits. Efficiently using models with a suitable abstraction level. To analyse fundamental electronic circuits at several abstraction levels.
E030610 Photonics	group work	assignment	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	practicum	report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	project	report	Apply basic concepts of project management Present clearly the project progress, results and solutions to fellow students. Understand the organization and execution of a project
E030230 Design of Analog Circuits and Building Blocks	practicum	skills test	Basic measurements on phase-locked systems.
E017210 Computer Programming	group work	report	be able to work together in a team with other students to realize a programming assignment
E099121 Engineering Project	group work	job performance assessment report peer assessment	Using electrical measurement equipment The ability to work in group awareness of imperfections of electrical components Awareness of the limitations and imperfections of electrical measurement equipment (noise, distorstion, frequency range, ...) set up a measurement protocol to validate the operation of electrical circuits Design a simple electrical circuit Measuring static and dynamic characteristics of electrical components
E065110 Materials in Electronics	practicum	report	To apply physical material models derived from physical miscroscopic material models. To be aware of the "black-box" basic models for common components in electrical engineering (electric, electronic and magnetic components) with respect to the materials that are used in these components.
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.
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
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
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
E030210 Analog Electronics	practicum	skills test	To make basic measurements on electronic circuits and systems.
E030610 Photonics	group work	assignment	To complete a task in team.
E099020 Cross-Course Project	project	report	Perform project work efficiently in a group. Present clearly the project progress, results and solutions to fellow students.
E017210 Computer Programming	project	report	be able to work together in a team with other students to realize a programming assignment
E099121 Engineering Project	group work	peer assessment	The ability to work in group

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	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
E030610 Photonics	lecture	oral examination	To search information in scientific and industrial photonics literature. Exposure to recent trends in photonics. To complete a task in team. Understanding of imaging systems, of wave phenomena (interference and diffraction), of operation and diversity in laser systems, of technology and operation of semiconductor components. To write a synthesizing article about a photonics subject. Analytical calculation skills with respect to simple lighting problems with incoherent sources, imaging systems with paraxial matrix method, Gaussian beam propagation, plane waves in 3-layer structures, basic characteristics of lasers. To gain knowledge with respect to the concepts: radiometric and photometric quantities and units, ray approximation, paraxial matrixformalism for imaging systems, aberrations, dispersion and absorption, plane wave, reflection and refraction, interference, Gaussian beams, diffraction, Maxwell's equations, TEM plane wave, polarisation, Fabry-Perot etalon, waveguide modes, optical fiber, photons, photonflux statistics, resonance processes, Kramers-Kronig, photon-atom interaction, thermal light, luminescent light, fluorescence, phosphorescence, lasers, gain, population inversion, Einstein relations, oscilation condition, pump systems, rate equations, cavity stability, laser modes, Q-switching and mode locking, LEDs and laser diodes, photodiode, CCD, solar cell, gas discharge lamp, incandescent lamp, color coordinate system, basic operation of displays
E010010 Signal Processing	lecture seminar: coached exercises practicum	written examination with open questions report	Understand and correctly interpret signal processing methods and models Inventarisation and comparison of suitable methods for solving a specific problem Selection of the best design method for accomplishing certain system requirements Convert a realistic problem statement into signal processing system specifications Understand and apply digital filter design methods
E099020 Cross-Course Project	lecture		Apply basic concepts of project management
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