Competence coverage matrix

GHENT UNIVERSITY

Bachelor of Science in Engineering

Chemical Engineering and Materials Science

Academic year 2021-2022

Legend:
T=teaching methods
E=evaluation methods

			General Courses																				Courses Related to the Main Subject													
			E001142 Basic Mathematics	E070080 Chemical Thermodynamics	E003043 Probability and Statistics	E066012 Materials Technology	E098512 Sustainability, Entrepreneurship and Ethics	E020061 Physics I	E001132 Mathematical Analysis I	E001460 Discrete Mathematics I	E070070 Chemistry: the Structure of Matter	E098513 Modelling, Making and Measuring	E015041 Informatics	E001222 Mathematical Analysis II	E000662 Geometry and Linear Algebra	E001321 Mathematical Analysis III	E020220 Physics II	E045120 Transport Phenomena	E040420 Mechanics of Materials	E076040 Sustainable Business Operations	E005020 Analysis of Systems and Signals	E007120 Modelling and Control of Dynamic Systems	E078310 Sustainable Use of Materials: Metals	E071010 Process Engineering	E068660 Polymers	E066020 Microstructure of Materials	E069110 Advanced Fibres and Derived Materials	E099040 Cross-Course Project	E002910 Introduction to Numerical Mathematics	E099141 Engineering Project	E021520 Statistical Physics and Molecular Structure	E070310 Organic Chemistry	E071020 Chemical Thermodynamics II	E071030 Analytical Techniques	E078320 Sustainable Use of Materials: Plastics and Derived Materials	E045910 Heat Engineering and Mass Transport
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 30	T E	T E		T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E		T E	T E	T E		T E	T E	T E	T E		T E	T E	T E	T E	T E	T E	T E
	Employ the basic sciences and techniques (statistics, ICT, CAD) in a creative and purposeful way.	T 12 E 10							T E	T E		T E	T E		T E			T E				T E					T	T E		T E				T E	T	
	Apply acquired knowledge of chemistry and materials in a creative way.	T 11 E 11		T E							T E														T E	T E	T E	T E		T E	T E	T E	T E		T E	
	Make use of mathematical modelling techniques for chemical/technological and material-related applications in a creative way.	T 7 E 7																				T E			T E			T E	T E	T E	T E					T E
	Have an understanding of transport phenomena and be aware of their importance in chemical technology and materials science.	T 4 E 4																T E								T E	T E									T E
	Be familiar with modelling of systems with feedback.	T 4 E 4																				T E					T E	T E		T E						
	Including working methods and the complexity of process techniques characteristic for chemical technology and materials science in own decision making.	T 3 E 3																									T E	T E							T E	
	Be aware of the continuous evolution of materials (catalytic agents, polymers, fibres, metal alloys, composite materials,…).	T 5 E 5																							T E	T E	T E			T E					T E	
	Be aware of the necessity of multidisciplinary in the process of establishing and applying requirements that meet quality- and environmental aspects and standard procedures in chemical and material-related industries.	T 5 E 3																									T E	T E		T				T	T E	
Scientific competences	Research and process technical and scientific information in a purposeful way.	T 10 E 9				T E	T E					T E	T E									T					T E	T E		T E	T E				T E	
	Employ standard models, methods and techniques in assignments.	T 22 E 21	T E		T E	T E			T E			T E	T E	T E	T E	T E			T E		T E	T E	T		T E	T E	T E	T E		T E	T E	T E			T E	T E
	Schematize and model phenomena, processes, and systems.	T 16 E 14			T E			T E	T E	T E				T E	T E	T E	T E			T E	T E	T						T E		T	T E		T E			T E
	Justify decision-making processes on rational grounds.	T 12 E 10		T E	T	T E	T E				T E	T E		T E		T E						T E				T E		T E		T						
	Apply essential concepts of chemical technology and materials science to case studies.	T 3 E 3																							T E		T E	T E								
	Apply essential concepts of chemical technology and materials science to the design of experiments and projects.	T 3 E 3																								T E	T E	T E								
	To be able to build on past research and design competences while understanding the limits of knowledge and methods.	T 4 E 4																						T E			T E	T E							T E	
Intellectual competences	Understand and structure learning experiences.	T 18 E 17	T E		T E	T E			T E				T E	T E	T E	T E				T E	T E	T				T E	T E	T E		T E	T E	T E			T E	
	Think in a conceptual, analytical, system-oriented, problem-solving and synthesizing way at different levels of abstraction.	T 27 E 24	T E		T E	T E	T E	T	T E	T E		T E	T E	T E	T E	T E	T E	T E	T E		T E	T	T E		T E		T E	T E	T E	T	T E	T E		T E	T E	
	Show precision, perseverance and critical reflection.	T 20 E 19	T E		T E	T E	T E		T E	T E				T E	T E	T E		T E			T E	T			T E	T E	T E	T E			T E		T E		T E	T E
	Show scientific curiosity.	T 14 E 12		T E		T	T E	T			T E	T E		T E			T E			T E	T E					T E		T E		T E	T E					
	Justify further studies or professional opportunities on rational grounds.	T 3 E 2				T															T E							T E								
	Be able to analyse problems in the area of chemical technology and materials science.	T 7 E 7																T E									T E	T E			T E	T E			T E	T E
	Be able to critically analyse the own approach for problem solving.	T 3 E 3																										T E			T E				T E	
Competences in cooperation and communication	Master scientific and discipline-specific technical terminology (also in English).	T 21 E 18	T E	T E	T E	T E	T E	T	T E		T	T E		T E	T E	T E	T E	T E				T				T E	T E	T E		T E		T E			T E	
	Carry out concrete assignments systematically.	T 10 E 10					T E					T E											T E			T E	T E	T E		T E	T E	T E				T E
	Work as part of a team.	T 6 E 6					T E					T E														T E	T E	T E		T E						
	Report results verbally, in writing, and graphically.	T 10 E 10				T E	T E					T E										T E			T E	T E		T E		T E		T E				T E
	To be able to apply an integrated project approach as part of a team.	T 5 E 5					T E					T E														T E		T E		T E						
Societal competences	Act in an ethical and social way.	T 5 E 4				T E	T E													T E								T E		T						
	Be aware of the business aspects of the engineering discipline.	T 3 E 2					T E													T E				T												
	Be aware of safety and environmental issues in chemical engineering and materials science.	T 6 E 3																					T E	T	T E					T		T E			T	
	Be aware of public and economic importance of the chemical and materials industry.	T 3																						T						T					T	
Profession-specific competence	Identify all sorts of professional situations and fields of activity for engineers in chemical processes and materials science.	T 5 E 3																						T			T E	T E		T						T E
			W 6 E 6	W 5 E 5	W 7 E 6	W 12 E 10	W 13 E 13	W 5 E 2	W 8 E 8	W 5 E 5	W 5 E 4	W 12 E 12	W 6 E 6	W 9 E 9	W 8 E 8	W 8 E 8	W 5 E 5	W 7 E 7	W 3 E 3	W 5 E 5	W 8 E 8	W 13 E 7	W 5 E 4	W 5 E 1	W 10 E 10	W 15 E 15	W 21 E 20	W 28 E 28	W 2 E 2	W 23 E 15	W 13 E 13	W 10 E 10	W 4 E 4	W 4 E 3	W 17 E 14	W 10 E 10

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

E045120	Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To understand the properties of fluids. To understand the similarities between transport of impulse, heat and mass. To solve problems of stationary heat transport. To know the basic laws of stationary heat transport and to be able to apply them. To understand the law of energy in open and closed systems and to be able to apply it. To master the laws of statics and dynamics and to be able to apply them.
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.
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.)
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.
E078310	Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes seminar	oral examination	Acquire knowledge and understanding about the fundamentals of sustainable technological society Estimate the sustainability of material use in a specific engineering application on the basis of material selection software and/or data. Understanding on how the type of metal (minor vs major) has an impact on its availability, applicability ans recyclability Acquire knowledge and discuss what possibilities there are to control material use in order to improve its sustainability. Summarize this complexity, taking into account multidisciplinary insights. Basic concepts with respect to sustainable use of materials, ranging from extraction to end-of-life, and understanding and being able to explain its role in society.
E068660	Polymers	lecture	written examination	Ability to define and describe preparation methods and polymerisation techniques of (co)polymers, modification reactions, tacticity, microstructure; behavior of polymers in the solid state and in solution, phase transitions, visco-elasticity, mechanical properties, characterization methods molar mass and phase transitions; introduction to polymer engineering; additives and recycling options. Get insights in relationship between chemical structure of monomer and polymerization reactions; relationship molecular and bulk properties of polymers, choice of characterization methods, relationship application and engineering technique; relationship chemical structure and recycling issues.
E066020	Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.

E069110	Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141	Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520	Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E070310	Organic Chemistry	lecture seminar: coached exercises practicum	written examination report job performance assessment participation	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E071020	Chemical Thermodynamics II	lecture seminar	written examination oral examination open book examination	Interpret important quantities of chemical thermodynamics and their molecular background: enthalpy, entropy, free energy, chemical potential. Calculating enthalpy and entropy changes of physicochemical reactions in a practical context (chemical reactions, phase transitions, electrodes and charge transport). Determine equilibrium lines on phase diagrams, and equilibrium in binary mixtures. To gain insight in the thermodynamic and statistical meaning of entropy.
E071030	Analytical Techniques	lecture seminar: coached exercises seminar practicum	written examination report peer assessment participation	Knowledge of the preparation methods of solid chemical materials Understanding and being able to explain the operating principle of the techniques covered Understanding of the possibilities and limitations of the most important techniques Knowledge of the principles and application of experimental techniques for chemical analysis, surface and material characterisation Skills in the analysis of sorption phenomena Insight into the interactions between molecules and the surface of a solid
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.
E045910	Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

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.
E045120 Transport Phenomena	seminar: practical PC room classes	open book examination	To solve problems of stationary heat transport.
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.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture		Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E071030 Analytical Techniques	lecture seminar: coached exercises seminar practicum	written examination report peer assessment job performance assessment participation	Knowledge of the preparation methods of solid chemical materials Understanding and being able to explain the operating principle of the techniques covered Understanding of the possibilities and limitations of the most important techniques Knowledge of the principles and application of experimental techniques for chemical analysis, surface and material characterisation Skills in the analysis of sorption phenomena Insight into the interactions between molecules and the surface of a solid
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar		Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

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.
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.
E068660 Polymers	practicum	skills test report	Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.

E070310	Organic Chemistry	lecture seminar: coached exercises	written examination	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E071020	Chemical Thermodynamics II	lecture seminar	written examination oral examination open book examination	Interpret important quantities of chemical thermodynamics and their molecular background: enthalpy, entropy, free energy, chemical potential. Calculating enthalpy and entropy changes of physicochemical reactions in a practical context (chemical reactions, phase transitions, electrodes and charge transport). Determine equilibrium lines on phase diagrams, and equilibrium in binary mixtures. To gain insight in the thermodynamic and statistical meaning of entropy.
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
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.
E068660 Polymers	lecture	written examination	Ability to define and describe preparation methods and polymerisation techniques of (co)polymers, modification reactions, tacticity, microstructure; behavior of polymers in the solid state and in solution, phase transitions, visco-elasticity, mechanical properties, characterization methods molar mass and phase transitions; introduction to polymer engineering; additives and recycling options.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E002910 Introduction to Numerical Mathematics	lecture seminar: practical PC room classes	written examination	Understanding and mastering of standard numerical methods for some basic problems (for (systems of) algebraic equations, initial problems for ODEs, boundary value problems and eigenvalue problems in 1D).
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen vooraf gegaan door ** werden niet teruggevonden in de studiefiche*			
E045120 Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To understand the properties of fluids. To understand the similarities between transport of impulse, heat and mass. To solve problems of stationary heat transport. To know the basic laws of stationary heat transport and to be able to apply them. To understand the law of energy in open and closed systems and to be able to apply it. To master the laws of statics and dynamics and to be able to apply them.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises	written examination	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 Being able to analyse feedback control systems using several stability criteria.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment

<< **EBingwCTMA1.5 Including working methods and the complexity of process techniques characteristic for chemical technology and materials science in own decision making.** *Competences in one/more scientific discipline(s)*

Course		Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*				
E069110	Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E068660 Polymers	lecture	written examination	Ability to define and describe preparation methods and polymerisation techniques of (co)polymers, modification reactions, tacticity, microstructure; behavior of polymers in the solid state and in solution, phase transitions, visco-elasticity, mechanical properties, characterization methods molar mass and phase transitions; introduction to polymer engineering; additives and recycling options. Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis. Get insights in relationship between chemical structure of monomer and polymerization reactions; relationship molecular and bulk properties of polymers, choice of characterization methods, relationship application and engineering technique; relationship chemical structure and recycling issues.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E071030 Analytical Techniques	lecture seminar: coached exercises seminar practicum		Knowledge of the preparation methods of solid chemical materials Understanding and being able to explain the operating principle of the techniques covered Understanding of the possibilities and limitations of the most important techniques Knowledge of the principles and application of experimental techniques for chemical analysis, surface and material characterisation Skills in the analysis of sorption phenomena Insight into the interactions between molecules and the surface of a solid
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

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.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	lecture: plenary exercises seminar: coached exercises	written examination	Being able to perform basic calculations quickly and efficiently by hand. To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To identify an appropriate probabilistic model for the analysis of an event or experiment
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E001132 Mathematical Analysis I	seminar	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E098513 Modelling, Making and Measuring	project	report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Use of software tools to make simulations and diagrams
E015041 Informatics	lecture seminar: practical PC room classes	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To design an algorithm solving a given problem, and to assess the complexity of this solution. To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	seminar	written examination open book examination	Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations. Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces.
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.
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.)
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
E078310 Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes seminar		Acquire knowledge and understanding about the fundamentals of sustainable technological society Estimate the sustainability of material use in a specific engineering application on the basis of material selection software and/or data. Understanding on how the type of metal (minor vs major) has an impact on its availability, applicability ans recyclability Acquire knowledge and discuss what possibilities there are to control material use in order to improve its sustainability. Summarize this complexity, taking into account multidisciplinary insights. Basic concepts with respect to sustainable use of materials, ranging from extraction to end-of-life, and understanding and being able to explain its role in society.
E068660 Polymers	practicum	participation report job performance assessment	Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis.

E066020	Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110	Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141	Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520	Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E070310	Organic Chemistry	lecture seminar: coached exercises practicum	written examination report job performance assessment participation	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.
E045910	Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

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.
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.
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.
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
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.)
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.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E071020 Chemical Thermodynamics II	lecture seminar	written examination oral examination open book examination	Determine equilibrium lines on phase diagrams, and equilibrium in binary mixtures. Calculating enthalpy and entropy changes of physicochemical reactions in a practical context (chemical reactions, phase transitions, electrodes and charge transport).

E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

Course	Teaching methods	Evaluation methods	Course learning outcome
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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.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.

E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E068660 Polymers	practicum	participation report job performance assessment	Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E071010 Process Engineering	lecture	open book examination participation	Read and understand PFD's and P&ID's Choose an appropriate maintenance tactic based on risk evaluation Understand types and working principles of steam turbines Use the information in sources for process technical data (handbooks, vendor catalogues, norms, guidelines) Recognize the hierarchichal structure of a chemical installation Gain insight in the influcence factors for design and construction of piping systems Understand the importance and the contents of the safety studies at the different life stages of a chemical installation Establish the logical links between the different steps of designing, engineering and construction of a chemical installation Have a basic insight in the different aspects of the exploitation and maintenance of a chemical installation
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E001142 Basic Mathematics	seminar: coached exercises	written examination	To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors. Being able to formulate correctly and with mathematical precision. Being able to make a correct reasoning and to write it down in a structured way.
E003043 Probability and Statistics	guided self-study seminar: coached exercises lecture	written examination with multiple choice questions open book examination	To reason and to work with multi-dimensional random variables To perform a linear regression and to interpret its results To understand and to apply methods for hypothesis testing To understand and to apply methods for (parameter) estimation To interpret and to judge the results of statistical sampling, and to represent them in an appropriate form To identify an appropriate probabilistic model for the analysis of an event or experiment To calculate probabilities of events and expectations of random variables
E066012 Materials Technology	guided self-study seminar: practical PC room classes seminar: coached exercises lecture	written examination	To name materials properties and to be able to distinguish between the different groups of materials To be able to select, by using a material selection software program, the most appropriate material for a specific engineering problem taking into account various material properties To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design a material with the desired properties. To be able to correlate the structure and properties of materials To understand the basic concepts of materials science and engineering and to be able to explain materials behaviour when used in specific situations.
E001132 Mathematical Analysis I	guided self-study	written examination open book examination	Being able to assess the convergence of numerical series and series of functions. To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and integrability. To know the structure of the general solution of a linear differential equation, as well as the lack of a general solution of a non-linear differential equation, to be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initial value problems. Being able to use Fourier series for solving partial differential equation by separation of variables. Being able to perform integral transforms, having acquired insight in their respective properties and being able to use them for solving initial value problems. Being able to construct and manipulate power series and Fourier series. Being able to use power series for solving ordinary differential equations.
E015041 Informatics	guided self-study seminar: practical PC room classes lecture	written examination open book examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm . To design an algorithm solving a given problem, and to assess the complexity of this solution. To master the basic concepts of objectorientation and to realize an objectoriented program in Python.
E001222 Mathematical Analysis II	guided self-study seminar: coached exercises lecture: plenary exercises lecture	written examination open book examination	Being able to perform the chain rules for differentiable functions. Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions. Being able to compute integrals in two and three dimensions by subsequent integration. Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems. Having acquired insight in the mathematical, geometric and physical interpretation of the notions limit, continuity, derivative, partial derivative, differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.
E000662 Geometry and Linear Algebra	guided self-study	written examination open book examination	Having acquired skills in the manipulation of vectors.
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations. To calculate complex line integrals both directly and by means of theoretical results. To have insight in the meaning of holomorphic functions and to be able to apply their properties. To calculate line and surface integrals both directly and by means of theoretical results. To have insight in the meaning of the notions line and surface integral and in the theorems of Green, Gauss and Stokes. To have acquired insight in the meaning of the notions scalar and vector potential, rotation and divergence free vector fields, conservative and solenoidal vector fields. To have acquired skills in calculations with the nabla operator.
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
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.)
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.

E066020	Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110	Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141	Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520	Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E070310	Organic Chemistry	lecture seminar: coached exercises	written examination	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

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.
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.
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.
E045120 Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To master the laws of statics and dynamics and to be able to apply them. To solve problems of stationary heat transport. To know the basic laws of stationary heat transport and to be able to apply them. To understand the law of energy in open and closed systems and to be able to apply it.
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.)
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.
E078310 Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes seminar	oral examination	Acquire knowledge and understanding about the fundamentals of sustainable technological society Estimate the sustainability of material use in a specific engineering application on the basis of material selection software and/or data. Understanding on how the type of metal (minor vs major) has an impact on its availability, applicability ans recyclability Acquire knowledge and discuss what possibilities there are to control material use in order to improve its sustainability. Summarize this complexity, taking into account multidisciplinary insights. Basic concepts with respect to sustainable use of materials, ranging from extraction to end-of-life, and understanding and being able to explain its role in society.
E068660 Polymers	lecture	written examination	Ability to define and describe preparation methods and polymerisation techniques of (co)polymers, modification reactions, tacticity, microstructure; behavior of polymers in the solid state and in solution, phase transitions, visco-elasticity, mechanical properties, characterization methods molar mass and phase transitions; introduction to polymer engineering; additives and recycling options. Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis. Get insights in relationship between chemical structure of monomer and polymerization reactions; relationship molecular and bulk properties of polymers, choice of characterization methods, relationship application and engineering technique; relationship chemical structure and recycling issues.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E002910 Introduction to Numerical Mathematics	lecture seminar: practical PC room classes	written examination	A critical usage of algorithms in practical applications using software.
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E070310 Organic Chemistry	lecture seminar: coached exercises	written examination	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E071030 Analytical Techniques	lecture seminar: coached exercises seminar practicum	written examination report peer assessment job performance assessment participation	Knowledge of the preparation methods of solid chemical materials Understanding and being able to explain the operating principle of the techniques covered Understanding of the possibilities and limitations of the most important techniques Knowledge of the principles and application of experimental techniques for chemical analysis, surface and material characterisation Skills in the analysis of sorption phenomena Insight into the interactions between molecules and the surface of a solid
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

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.
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.
E045120 Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To understand the properties of fluids. To solve problems of stationary heat transport. To know the basic laws of stationary heat transport and to be able to apply them. To understand the law of energy in open and closed systems and to be able to apply it. To master the laws of statics and dynamics and to be able to apply them.

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.)
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.
E068660	Polymers	lecture	written examination	Ability to define and describe preparation methods and polymerisation techniques of (co)polymers, modification reactions, tacticity, microstructure; behavior of polymers in the solid state and in solution, phase transitions, visco-elasticity, mechanical properties, characterization methods molar mass and phase transitions; introduction to polymer engineering; additives and recycling options. Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis. Get insights in relationship between chemical structure of monomer and polymerization reactions; relationship molecular and bulk properties of polymers, choice of characterization methods, relationship application and engineering technique; relationship chemical structure and recycling issues.
E066020	Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110	Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E021520	Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.

E071020	Chemical Thermodynamics II	seminar	written examination open book examination	Interpret important quantities of chemical thermodynamics and their molecular background: enthalpy, entropy, free energy, chemical potential. Calculating enthalpy and entropy changes of physicochemical reactions in a practical context (chemical reactions, phase transitions, electrodes and charge transport). Determine equilibrium lines on phase diagrams, and equilibrium in binary mixtures. To gain insight in the thermodynamic and statistical meaning of entropy.
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.
E045910	Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

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.
E076040 Sustainable Business Operations	lecture	written examination with open questions written examination with multiple choice questions	Understanding sustainability aspects in an economic context
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.)

E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.

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.)
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E045120 Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To understand the properties of fluids. To understand the similarities between transport of impulse, heat and mass. To solve problems of stationary heat transport. To know the basic laws of stationary heat transport and to be able to apply them. To understand the law of energy in open and closed systems and to be able to apply it. To master the laws of statics and dynamics and to be able to apply them.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E070310 Organic Chemistry	lecture seminar: coached exercises	written examination	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.
E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
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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.
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.
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.
E045120 Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To understand the properties of fluids. To understand the similarities between transport of impulse, heat and mass. To solve problems of stationary heat transport. To know the basic laws of stationary heat transport and to be able to apply them. To understand the law of energy in open and closed systems and to be able to apply it. To master the laws of statics and dynamics and to be able to apply them.

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.
E066020	Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110	Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141	Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E070310	Organic Chemistry	lecture seminar: coached exercises	written examination	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E078320	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

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.
E078310 Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes seminar	oral examination	Acquire knowledge and understanding about the fundamentals of sustainable technological society Estimate the sustainability of material use in a specific engineering application on the basis of material selection software and/or data. Understanding on how the type of metal (minor vs major) has an impact on its availability, applicability ans recyclability Acquire knowledge and discuss what possibilities there are to control material use in order to improve its sustainability. Summarize this complexity, taking into account multidisciplinary insights. Basic concepts with respect to sustainable use of materials, ranging from extraction to end-of-life, and understanding and being able to explain its role in society.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale. Solve the Schrödinger equation for basic potential problems (1D or central). Understand the basic concepts of quantum mechanics (e.g. wave-particle duality, Schrödinger equation, orbital momentum, spherical harmonics). Understand the relation between the macroscopic and microscopic description of matter. Understand the importance of symmetry for spectroscopy. Master the quantum mechanical description of the hydrogen atom. Understand the various statistical distribution functions and apply them to systems with many degrees of freedom. Master and apply the basic concepts of statistical physics. Derive statistical quantities such as partition functions for simple and complex systems and apply them to determine macroscopically observable quantities.

E070310 Organic Chemistry	lecture seminar: coached exercises practicum	written examination report job performance assessment participation	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

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.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment

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
E068660 Polymers	practicum	participation report job performance assessment	Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis.
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E070310 Organic Chemistry	practicum	participation report job performance assessment	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.

E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.

Course	Teaching methods	Evaluation methods	Course learning outcome
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E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E098513 Modelling, Making and Measuring	lecture project	participation report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Oral presentation Writing reports
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics, constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation; characteristics and origin of martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect. Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties; solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less and diffusion-controlled phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations; understand thermal and material flux during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase transformations with and without diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical transformations; understand relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the emergence of a recrystallization texture.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment

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
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment

Course	Teaching methods	Evaluation methods	Course learning outcome
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E098512 Sustainability, Entrepreneurship and Ethics	lecture project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E076040 Sustainable Business Operations	lecture	written examination with open questions assignment written examination with multiple choice questions	Understand the technique of financial balance sheet reading and be able to apply it practically in simple accounting exercises Mastering the basic concepts of macroeconomics and microeconomy: law of supply and demand, markets (perfect competition, monopoly, oligopoly, game theory) Understanding the coherence between the different stakeholders of the company Being able to make a simple investment analysis and apply the concept of time value of money in all aspects of investment analysis Being able to make a complete costing for a product or a service Being able to distinguish between fixed, variable, direct and indirect costs Be able to analyze and assess the data of a company's balance sheet Understanding sustainability aspects in an economic context
E071010 Process Engineering	lecture		Have a basic insight in the different aspects of the exploitation and maintenance of a chemical installation Recognize the hierarchichal structure of a chemical installation

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E078310 Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes seminar	oral examination	Acquire knowledge and understanding about the fundamentals of sustainable technological society Estimate the sustainability of material use in a specific engineering application on the basis of material selection software and/or data. Understanding on how the type of metal (minor vs major) has an impact on its availability, applicability ans recyclability Acquire knowledge and discuss what possibilities there are to control material use in order to improve its sustainability. Summarize this complexity, taking into account multidisciplinary insights. Basic concepts with respect to sustainable use of materials, ranging from extraction to end-of-life, and understanding and being able to explain its role in society.
E071010 Process Engineering	lecture		Have a basic insight in the different aspects of the exploitation and maintenance of a chemical installation Understand the importance and the contents of the safety studies at the different life stages of a chemical installation
E068660 Polymers	practicum	participation report job performance assessment	Obtaining practical synthetic skills, being able to apply correlations between chemical (micro)structure and end properties; having practical skills with regard to characterization methods for polymer analysis.
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E070310 Organic Chemistry	practicum	participation report job performance assessment	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most important organic molecules, describe stereochemistry of organic molecules, describe separation methods of molecules. Showing ability to make use of theory in creative way when designing chemical reactions; ability to use laboratory equipment; solving capability. Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of organic molecules; being able to develop multi-step reaction sequences.
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar		Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
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E071010 Process Engineering	lecture		Have a basic insight in the different aspects of the exploitation and maintenance of a chemical installation Recognize the hierarchichal structure of a chemical installation
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar		Gaining knowledge concerning the fundamentals of sustainable technology and related concepts. Be able to assess the sustainability of material use in a specific application based on data available in literature or specific software packages. Gaining knowledge concerning the possibilities to affect the sustainability of material use and improve it. Recognizing and summarizing the multi-disciplinarity insights regarding sustainable material use. Be able to explain basic concepts regarding sustainable material use and position its role in society.

Course	Teaching methods	Evaluation methods	Course learning outcome
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E071010 Process Engineering	lecture		Have a basic insight in the different aspects of the exploitation and maintenance of a chemical installation Establish the logical links between the different steps of designing, engineering and construction of a chemical installation
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials. Be familiar with the most used polymers, fibers and derived materials used in the engineering of high-end applications Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and material sciences Reporting and presenting the acquired results and insights in a concise, yet complete manner Critically evaluating the acquired insights in a social, ethical and economic framework
E099141 Engineering Project	excursion seminar: coached exercises project lecture		understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines oral presentation of obtained results and insights writing compacte but complete reports work accurately with measuring and analytical equipment
E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	To construct Fick's law To construct mass conservation equations To understand mass transfer Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in chemical industry To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and processes, related to heat transfer.