Competence coverage	matrix								(General	Course	es												Cour	ses Rela	ted to the	Main S	Subject			
HENT JNIVERSITY Bachelor of Science in	Engineering		nics	ø		neurship and Ethics			e of Matter	Measuring		=	lgebra	=			perations	d Signals	of Dynamic Systems	erials: Metals			ials	erived Materials		al Mathematics	Molecular Structure		nics II	erials: Plastics and	פוומוט. ד ומסמיטי ביייב
Chemical Engineering	and Materials Science	atics	rmodynar	d Statistic	ypology	Entrepre	Applyeie	ematics I	Structure	king and l		Analysis I	I Linear A	Analysis I	9	Materials	usiness C	stems an	Control	se of Mat	neering		of Materi	res and D	Project	to Numeric	sics and I	nistry	rmodynar	hniques se of Mat	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Academic year 2021-20	022	Mathem	nical The	ability and	rials Tech	ainability,	ics l	emancary ete Matho	nistry: the	elling, Ma	natics	ematical	netry and	ematical	ics II	apoil rine	ainable Bı	sis of Sy	elling and	ainable U	ess Engin	ners	structure	nced Fib	s-Course	duction to		nic Chem	nical The	/tical Tec	all lable of
_egend:		42 Basid	80 Chen	43 Prob	12 Mate	12 Susta	61 Phys	460 Discr	70 Chen	13 Mode	41 Inforr	22 Math	62 Geor	21 Math	20 Phys	20 Mech	40 Susta	20 Analy	20 Mode	10 Susta	1010 Proce	60 Polyr	20 Micro	10 Adva	40 Cros	10 Introc 41 Engir	1520 Statis	10 Orga	1020 Chen	Anal	later
T=teaching methods E=evaluation methods		E0011	E070080	E0030	E066012	E098512	E020061	E0014	E070070	E0985.	E015041	E001222	E000662	E001321	E020220	E043120	E076040	E005020	E007120	E078310	E0710	E068660	E066020	E069110	E099040	E002910	E0215	E070310	E0710	E071030 E078320	Derived N
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 E	E		T E	T E	T T	E	E	T E	T E	T E	T E	T E	T 1	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 T 12 a creative and purposeful way.						1 E	T		T	T		T E		7	「 =			T E					Т	T E	T				T E	Т
	Apply acquired knowledge of chemistry and materials in a creative T 11 way.		T E						T		_		_			_						T E	T E	T E	T E	T	т	T E	T E		T E
	Make use of mathematical modelling techniques for chemical/technological and material-related applications in a creative way.																		T E			T E			T E	T T	T E				
	Have an understanding of transport phenomena and be aware of their importance in chemical technology and materials science.														1	r =							T E	T E							
	Be familiar with modelling of systems with feedback.																		T E					T E	T E	T					
	Including working methods and the complexity of process techniques characteristic for chemical technology and materials science in own decision making.																							T E	T E						T E
	Be aware of the continuous evolution of materials (catalytic agents, T 5 polymers, fibres, metal alloys, composite materials,).																					T E	T E	T E		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.																							E	E	Т				T '	T E
scientific competences	Research and process technical and scientific information in a purposeful way.)			T E	T E				T E	T E								Т					T E	T E	T					T E
	Employ standard models, methods and techniques in assignments.			T E	T E		T			T E	T E	T E	T E	T E		T		T E	T E	Т		T E	T E	T E	T E	T	Т	T			T E
	Schematize and model phenomena, processes, and systems.			T E			T T	T				T E	T E	T E	T E		T E	T E	Т						T E	Т	T		T E		+
	Justify decision-making processes on rational grounds. T 12 E 10)	T E	Т	T E	T E			T E	T E		T E		T E					T E				T E		T E	Т					
	Apply essential concepts of chemical technology and materials science to case studies.																					E		E	T E						
	Apply essential concepts of chemical technology and materials science to the design of experiments and projects.																						E	E	E						
	To be able to build on past research and design competences while understanding the limits of knowledge and methods.																				T E			T E	T E					ı	T E
ntellectual competences	Understand and structure learning experiences. T 18 E 17	E		E	T E		E				E T	T E	T E	T E			T E	T E	T			_	T E	T E	T E	E		E		-	T E
	Think in a conceptual, analytical, system-oriented, problem-solving T 27 and synthesizing way at different levels of abstraction.	E		Ē	E	E	E	Ė		Ė	Ė	E	Ë	E	E E	E		E	<u>'</u>	Ė		Ë	_	E	Ë	Ė	E	Ė	_	Ė	E
	Show precision, perseverance and critical reflection. T 20 E 19 Show scientific curiosity. T 14	E		Ė	E T	E T	T	Ė	Т.			E T	E	E	T	•	т	E	'			Ė	E	E	E T		E		E		E
	Justify further studies or professional opportunities on rational T3	2	E		т	Ē			E	E		E			E		E	E T					E		E T	E	E				_
	grounds. E 2 Be able to analyse problems in the area of chemical technology and materials science. T 7 E 7] 	г <u>=</u>		E						T E	E T E		T	T E			T E
	Be able to critically analyse the own approach for problem solving.																								Ţ						T
Competences in	Master scientific and discipline-specific technical terminology (also T 21 in English).		1 -	T	T E	T E	T T		Т	T		T E	T E	T	T 1				Т				T E	T E	T E	T		T			T F
cooperation and communication	Carry out concrete assignments systematically.)	E	E		T E		-		T		-	_	E	- '	-				T E			T E	T E	T E	T	т	Т			_
	Work as part of a team. T 6 E 6					T E				T										=			T E	T E	T E	T	•	-			
	Report results verbally, in writing, and graphically. T 10 E 10)			T E	T E				T									T E			T E	T E	_	T E	T		T E			
	To be able to apply an integrated project approach as part of a team.					T E				T E													T E		T E	T	-				
Societal competences	Act in an ethical and social way. T 5 E 4				T E	T E											T E								T E	Т					
	Be aware of the business aspects of the engineering discipline.					T E											T E				Т										
	Be aware of safety and environmental issues in chemical engineering and materials science.																			T E	Т	T E				Т		E			Т
	Be aware of public and economic importance of the chemical and T 3 materials industry.																				T					Т					T
Profession-specific competence	Identify all sorts of professional situations and fields of activity for engineers in chemical processes and materials science.																				Т			T E	T E	Т					
		W 6	W 5	W 7	W 12	W 13 W	5 W 8 2 E 8	W 5	W 5	W 12	W 6	W 9 V	/ 8 W	8 W	5 W 7	W 3	W 5	W 8	W 13	W 5	N 5	V 10	N 15	N 21	W 28 W	/2 W 2	3 W 13	W 10	W 4	W 4 W · E 3 E 1	17 V

EBingwALG1.1 Have a clear understanding of the basic sciences and basic engineering sciences, and have the ability to apply them in a creative and purposeful way in the chosen specific engineering discipline.

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Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche		
	governaem m ae staatenene		
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.
5070000 OL			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 material with the desired properties.
E098512 Sustainability, Entrepreneurship and Ethics	lecture	participation	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 us in specific situations. Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the
	lecture project	assignment	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 init 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	written examination	Distinguishing and applying fundamental algebraic and discrete structures.
	seminar: coached exercises practicum lecture	open book examination	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
E098513 Modelling, Making and Measuring	project	report	Being able to write the electron configuration of atoms and ions. 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,
E000662 Geometry and Linear Algebra	guided self-study lecture: plenary exercises seminar lecture	open book examination	differentiability, gradient, multiple integral, Jacobian and co-ordinate transform. 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 transform on them. Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a
E001321 Mathematical Analysis III	lecture seminar: coached exercises	written examination	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. To master the basic theory of curves. To apply the residue theorem in a variety of situations.
	lecture: plenary exercises		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.

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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
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
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	recycling issues. Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and temary 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 allo

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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 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
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Insight into the interactions between molecules and the surface of a solid 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.

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<<	EBingwALG1.2 Employ the basic	• ` `	· · · · ·	· · · · · · · · · · · · · · · · · · ·	Competences in one/more scientific discipline(s
Course		Teaching methods	Evaluation methods	Course learning outcome	
voot: leer- en	evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche			
:001132 N	fathematical Analysis I	lecture lecture: plenary exercises seminar	written examination	Being able to assess the convergence of numerical series and ser To know the structure of the general solution of a linear differential linear differential equation, to be able to solve specific differential equations and to check the extra value problems. Being able to use Fourier series for solving partial differential equations able to perform integral transforms, having acquired insight solving initial value problems. Being able to construct and manipulate power series and Fourier series able to use power series for solving ordinary differential equations.	I equation, as well as the lack of a general solution of a non- istence and uniqueness conditions for the corresponding initia ation by separation of variables. in their respective properties and being able to use them for series.
=001460 E	Discrete Mathematics I	practicum	written examination	Distinguishing and applying fundamental algebraic and discrete st	
2001100 2		praoticam	willon oxaminator	Being fluent in graph algorithms and applying them to real problem Deploying deductively correct reasonings in an independent way. Evaluating logical reasonings with respect to correctness / identify Deploying mathematical reasoning and proof argumentation. Using basic concepts from set theory, group theory, combinatorics	n situations.
E098513 N	Nodelling, Making and Measuring	project	participation	Use of software tools to make simulations and diagrams	
E015041 li	oformatics	lecture	report written examination	To master the structured programming paradigm and to realize a R	Python program, using this structured programming paradigm
	Geometry and Linear Algebra			To master the basic concepts of objectorientation and to realize a realize and the basic concepts of objectorientation and to realize and Being able to write down the respective reduced forms of a matrix Having acquired skills in the manipulation of vectors. Being able to write down vector representations of curves and surface on them. Being able to construct an orthogonal basis by means of the Gram subspace and to perform a least squares algorithm. Being able to give the matrix representation and the corresponding threedimensional space, or of a linear transform between abstract vector spaces.	and use them for solving systems of linear equations. faces, and to perform chains of active and passive transforms n-Schmidt-procedure, to project a vector orthogonally onto a
F045120 T	ransport Phenomena	seminar: practical PC room classes	open book examination	To solve problems of stationary heat transport.	
	<u>'</u>	Serminar. praetical i e reem diasses	open book examination	· · · ·	
E007120 N	Modelling and Control of Dynamic Systems	lecture seminar: coached exercises	written examination	To evaluate in a correct way the results of computer simulations a	nd numerical techniques when designing feedback
E069110 A	dvanced Fibres and Derived Materials	excursion seminar lecture		control systems. Make the link between the chemical and physical structure of the r behavior. Obtain knowledge and understanding of advanced fibres / high pe Be familiar with the most used polymers, fibers and derived materi Use of Computer Aided Engineering tools such as finite element metals.	rformance fibres and derived materials. ials used in the engineering of high-end applications
E099040 C	Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an i of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem for question in a systematic manner Apply previously acquired knowledge to a (for the concerned stude material sciences Reporting and presenting the acquired results and insights in a concernically evaluating the acquired insights in a social, ethical and en	ndependent manner and applying this information in the area rmulation into a concrete research question and address this ent) new problem in the area of chemical engineering and ncise, yet complete manner
E099141 E	ngineering Project	excursion seminar: coached exercises project	oral examination report job performance assessment	understanding the working principle of measuring and analytical ed develop a critical mindset to procedures, best practices, and guide oral presentation of obtained results and insights	quipment
		lecture	skills test participation	writing compacte but complete reports work accurately with measuring and analytical equipment	
E071030 A	nalytical 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 Understanding of the possibilities and limitations of the most important Knowledge of the principles and application of experimental technic characterisation Skills in the analysis of sorption phenomena	the techniques covered rtant techniques
				Insight into the interactions between molecules and the surface of	
	Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar		Gaining knowledge concerning the fundamentals of sustainable te Be able to assess the sustainability of material use in a specific ap software packages. Gaining knowledge concerning the possibilities to affect the sustai Recognizing and summarizing the multi-disciplinarity insights rega Be able to explain basic concepts regarding sustainable material u	pplication based on data available in literature or specific nability of material use and improve it. rding sustainable material use.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	iggevonden 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 an ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion mechanisms, Fick's laws, mixed diffusion-controlled movement of phase boundaries, 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 kinetic 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. Skilis: 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 the microstructure of fixed solutions in function of the affinity between the atoms; be able to distinguish the energy of the different lattice errors and their effect on
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	emergence of a recrystallization texture. 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.
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	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. Searching, processing and interpreting relevant information in an independent manner and applying this information in the are 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.

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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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	ggevonden 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 method 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.

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Course	science.	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en	evaluatievormen voorafgegaan door ** werden niet ter	uggevonden in de studiefiche		
E045120 T	ransport 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.
E066020 M	licrostructure of Materials	lecture	written examination with open	To master the laws of statics and dynamics and to be able to apply them. Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary ar
		practicum	questions report open book examination	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 kineti 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; predictions 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 connection between the state diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be a
				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-le
				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.
∃069110 A	dvanced Fibres and Derived Materials	excursion seminar	oral examination assignment	Make the link between the chemical and physical structure of the materials and how these result in specific properties and behavior.
		lecture	participation	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.
:045910 H	eat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation	To construct Fick's law To construct mass conservation equations To understand mass transfer
			participation oral examination	Calculate different types of heat transfer (such as conduction, convection and radiation). To dermine concentration profiles
			open book examination	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.

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EBingwCTMA1.4 Be familiar with modelling of systems with feedback.

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Competences in one/more scientific discipline(s)

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	ggevonden 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

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Competences in one/more scientific discipline(s)

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet tel	uggevonden 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.

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			ymers, fibres, metal alloys, composite materials,). Competences in one/more scientific discipline
Course Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	Teaching methods	Evaluation methods	Course learning outcome
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 method 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
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	recycling issues. 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-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetic constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-state transformations, nucleation and kinetics of the solid-state transformations, nucleation and kinetics of the solid-state transformations, and kinetics of the solid-state transformations, nucleation and kinetics of the 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: understand the errors and their effect on equilibria; understand diffusion model
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.
099141 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
078320 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.

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EBingwCTMA1.7 Be aware of the necessity of multidisciplinary in the process of establishing and applying requirements that meet quality- and Competences in one/more scientific discipline(s) environmental aspects and standard procedures in chemical and material-related industries.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet ter	uggevonden 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	O40 Cross-Course Project guided self-study project lecture group work demonstration Apply previously acquired knowledge to a (for the concerned student) new problem in an insights in a concise, yet complete manner		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
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
071030 Analytical Techniques lecture seminar: coached exercises seminar Knowledge of the preparation methods of solid chemical materials Understanding and being able to explain the operating principle of the techniques covere seminar Understanding of the possibilities and limitations of the most important techniques		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	
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Insight into the interactions between molecules and the surface of a solid 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.

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EBingwALG2.1 Research and process technical and scientific information in a purposeful way.				
Course		Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- ei	n evaluatievormen voorafgegaan door ** werden niet terug	gevonden 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 use 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
E099141	Engineering Project	excursion seminar: coached exercises project lecture	oral examination report job performance assessment skills test participation	Critically evaluating the acquired insights in a social, ethical and economic framework 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.
	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.

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Course	d models, methods and techniqu Teaching methods	Evaluation methods	Scientific competence Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet tel	•		3 · · · · · · · · · · · · · · · · · · ·
E001142 Basic Mathematics	lecture: plenary exercises	written examination	Being able to perform basic calculations quickly and efficiently by hand.
E003043 Probability and Statistics	seminar: coached exercises guided self-study	written examination with multiple	To have a thorough knowledge of the topics matrices, complex numbers, elementary functions and vectors. To reason and to work with multi-dimensional random variables
	seminar: coached exercises lecture	choice questions open book examination	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 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 use 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 initia 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.
E009512 Modelling Making and Manauring	project	roport	Being able to use power series for solving ordinary differential equations. Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E098513 Modelling, Making and Measuring	project	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 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
E001321 Mathematical Analysis III	lecture seminar: coached exercises lecture: plenary exercises	written examination	transform between abstract vector spaces. 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.
E005020 Analysis of Systems and Signals	lecture seminar: coached exercises	written examination with multiple choice questions	Applications of the problem solving methods in elasticity theory. 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.

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job performance assessment to characterization methods for polymer analysis.

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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
E069110 Advanced Fibres and Derived Materials	excursion	oral examination	recrystallization texture. Make the link between the chemical and physical structure of the materials and how these result in specific properties and
2000 TTO Advanced Fibres and Derived Materials	seminar lecture	assignment participation	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.
E045910 Heat Engineering and Mass Transport	lecture seminar: coached exercises	written examination report simulation participation oral examination open book examination	Be able to explain basic concepts regarding sustainable material use and position its role in society. 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.

written examination with open Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and

E066020 Microstructure of Materials

lecture

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EBingwALG2.3 Schematize and r Course	Teaching methods	Evaluation methods	Scientific competence Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	_		
E003043 Probability and Statistics	guided self-study	written examination with multiple	To reason and to work with multi-dimensional random variables
•	seminar: coached exercises lecture	choice questions open book examination	To identify an appropriate probabilistic model for the analysis of an event or experiment
E020061 Physics I	demonstration	written examination	To understand the physical laws and concepts of the covered chapters.
E001122 Mathematical Analysis I	lecture	written examination	To be able to solve problems by applying these laws and concepts. 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-
E001132 Mathematical Analysis I	lecture lecture: plenary exercises	written examination	linear differential equation, to
	seminar		be able to solve specific differential equations and to check the existence and uniqueness conditions for the corresponding initia value problems.
E001460 Discrete Mathematics I	guided self-study	written examination	Distinguishing and applying fundamental algebraic and discrete structures.
	seminar: coached exercises practicum	open book examination	Being fluent in graph algorithms and applying them to real problem situations. Deploying deductively correct reasonings in an independent way.
	lecture		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	written examination	Being able to perform the chain rules for differentiable functions.
	seminar: coached exercises lecture: plenary exercises	open book examination	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.
	lecture		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	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
	seminar	·	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	written examination	To master the basic theory of curves.
	seminar: coached exercises lecture: plenary exercises		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	written examination	To be able to solve physics problems by applying these laws and concepts.
E076040 Sustainable Business Operations	lecture lecture	participation written examination with open	To understand the physical laws and concepts of the covered chapters. Understand the technique of financial balance sheet reading and be able to apply it practically in simple accounting exercises
E070040 Oustainable Business Operations	lecture	questions written examination with multiple	
		choice questions	
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		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in
	seminar: coached exercises		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	job performance assessment	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering
	lecture	report	and material sciences
	group work demonstration		Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this question in a systematic
	demonstration		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
E099141 Engineering Project	excursion		Critically evaluating the acquired insights in a social, ethical and economic framework understanding the working principle of measuring and analytical equipment
E099141 Engineering Froject	seminar: coached exercises		develop a critical mindset to procedures, best practices, and guidelines
	project lecture		oral presentation of obtained results and insights writing compacte but complete reports
	iootaio		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).
	Seminar. Coached Exercises		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
			magrapapiaelly charmable grantities
E071020 Chemical Thermodynamics II	lecture	written examination	macroscopically observable quantities. Determine equilibrium lines on phase diagrams, and equilibrium in binary mixtures.
E071020 Chemical Thermodynamics II	lecture seminar	written examination oral examination open book examination	macroscopically observable quantities. 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

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E045910 Heat Engineering and Mass Transport

lecture

seminar: coached exercises

written examination

report

open book examination

simulation participation oral examination

To construct mass conservation equations

To understand mass transfer

To construct Fick's law

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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	_		
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	written examination	Being able to perform stoichiometric calculations.

Writing reports

Oral presentation

partial derivative,

vector fields.

control systems.

constitutional

ternary state diagrams;

state transformations,

characteristics and origin of

solving diffusion problems

characteristics of the state diagrams;

microstructure in solid formation;

understand the mechanisms during the annealing process.

between the state

to distinguish the energy

and diffusion-controlled

processes in solids; be able to

understand thermal and material flux

transformations with and without

transformations; understand

emergence of a recrystallization texture.

mechanisms, Fick's laws, mixed

diffusion-controlled movement of

To master the basic theory of curves.

conservative and solenoidal

Identify and describe the different types of intermolecular interactions.

Being able to order atoms and ions based on their periodic properties Being able to write the electron configuration of atoms and ions.

Identify and describe the different types of chemical bonding.

Being able to perform the chain rules for differentiable functions.

To apply the residue theorem in a variety of situations.

To have acquired skills in calculations with the nabla operator.

Being able to determine the molecular geometry of covalent compounds.

Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions.

To have insight in the meaning of holomorphic functions and to be able to apply their properties.

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,

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,

To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback

order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion

diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase boundary, diffusionless and

To have insight regarding the static and dynamic behaviour of systems and to apply this insight when designing feedback loops.

Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and

phase boundaries, military and civil transformations; nucleation and growth of dendrites during coagulation, coagulation kinetics,

hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystallization, grain growth, texture; solid-

recognizing order disorder and its consequences; make connections between diffusion coefficient and other atomic properties;

predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer;

Insights: understanding the structure of fixed solutions in function of the affinity between the atoms; be able to make connections

diagrams and the affinity between the alloying elements; understanding the effect of order disorder on material behavior; be able

explain the structure of the microstructure for a single and multiphase material; understand the difference between diffusion-less

relationships between mother and daughter structure; recognize drivers of recovery and recrystallization; be able to explain the

errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon annealing after cold working;

of the different lattice errors and their effect on equilibria; understand diffusion models and interactions during diffusion

phase transformation; recognize the importance of the interplay between nucleation and growth in all transformations;

during solidification; know differences between possible coagulation mechanisms; understand the kinetics of the phase

diffusion, be able to explain the shape of the TTT diagrams; recognize differences between massive and classical

nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of the massive transformation;

Skills: applying coagulation theory in industrial situations; gain insight into the origin of phases; deeper insight into the

such as carbonization and decarbonisation; be able to approach complex diffusion problems; prediction of the expected

martensite, path distortion, crystallographic relationships during phase transformations, shape memory effect.

Being able to compute integrals in two and three dimensions by subsequent integration.

differentiability, gradient, multiple integral, Jacobian and co-ordinate transform.

To calculate complex line integrals both directly and by means of theoretical results.

To implement modeling and control on small scale setups by using personal laptop

To calculate line and surface integrals both directly and by means of theoretical results.

open book examination

written examination

written examination

written examination

written examination with open

open book examination

report

questions

open book examination

report

seminar: coached exercises

seminar: coached exercises

seminar: coached exercises lecture: plenary exercises

seminar: coached exercises

lecture: plenary exercises

lecture: plenary exercises

lecture

project

lecture

lecture

lecture

lecture

practicum

practicum

guided self-study

E098513 Modelling, Making and Measuring

E001222 Mathematical Analysis II

E001321 Mathematical Analysis III

E066020 Microstructure of Materials

E007120 Modelling and Control of Dynamic Systems

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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

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EBingwCTMA2.1 Apply essential concepts of chemical technology and materials science to case studies.

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Scientific competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet te	ruggevonden 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

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ourse	ofacacan door ** worden niet to	Teaching methods	Evaluation methods	Course learning outcome	
oot: leer- en evaluatievormen voor	afgegaan door ** werden niet tei	ruggevonden in de studietiche			
E066020 Microstructure of M	laterials	lecture practicum	written examination with open questions report open book examination	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynan ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium con mechanisms, Fick's laws, mixed diffusion in solid solutions; grain boundary, interfacial energy and interfacial migration; phase diffusion-controlled movement of phase boundaries, military and civil transformations; nucleation and growth of dendrites duri constitutional hypothermia, eutectic coagulation; recovery, polygonization, deformation texture; recrystalliz state transformations, nucleation and kinetics of the solid-state transformations, TTT and CCT diagrams; kinetics of martensite, path distortion, crystallographic relationships during phase transformations, shap Skills: applying coagulation theory in industrial situations; gain insight into the origin of phase characteristics of the state diagrams; recognizing order disorder and its consequences; make connections between diffusion coeff solving diffusion problems such as carbonization and decarbonisation; be able to approach complex diffusion problems microstructure in solid formation; predict influence factors on kinetics; recognizing situations where massive transformation or predict the effect of lattice errors (quantity and distribution) on the mechanical behavior; predicting microstructure upon understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function of the affinity between the between the state diagrams and the affinity between the alloying elements; understand diffusion models and in processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand to distinguish the energy of the different lattice errors and their effect on equilibria; understand diffusion models and in processes in solids; be able to explain the structure of the microstructure for a single and multiphase material; understand transformations wi	icentration; atomic diffusion be boundary, diffusionless and and coagulation, coagulation kinetics cation, grain growth, texture; solid- of the massive transformation; be memory effect. bes; deeper insight into the ficient and other atomic properties; s; prediction of the expected ccurs; understand texture transfer; annealing after cold working; atoms; be able to make connection disorder on material behavior; be able anteractions during diffusion the difference between diffusion-less with in all transformations; and the kinetics of the phase massive and classical
E069110 Advanced Fibres a	nd Derived Materials	excursion	oral examination	emergence of a recrystallization texture. Make the link between the chemical and physical structure of the materials and how these re	esult in specific properties and
		seminar lecture	assignment participation	behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derive Be familiar with the most used polymers, fibers and derived materials used in the engineering Use of Computer Aided Engineering tools such as finite element modelling for specific engineering tools.	ved materials. g of high-end applications
E099040 Cross-Course Proje	ect	guided self-study project lecture group work demonstration	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and a of chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into a concrete requestion in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new problem in the are 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	esearch question and address this ea of chemical engineering and

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EBingwCTMA2.3 To be able to build on past research and design competences while understanding the limits of knowledge and methods.

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	COMPONICION

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	uggevonden 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.

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<<	EBingwALG3.1 Understand and structure learning experiences.	Intellectual competer
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Course		Teaching methods	Evaluation methods	Course learning outcome
loot: leer- en evalu	uatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche		
001142 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.
002042 Drobe	ability and Statistics	guided self-study	written examination with multiple	Being able to make a correct reasoning and to write it down in a structured way. To reason and to work with multi-dimensional random variables
103043 F100a	ability and Statistics	seminar: coached exercises	choice questions	To perform a linear regression and to interpret its results
		lecture	open book examination	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
066012 Mater	rials Technology	guided self-study	written examination	To name materials properties and to be able to distinguish between the different groups of materials
		seminar: practical PC room classes		To be able to select, by using a material selection software program, the most appropriate material for a specific engineering
		seminar: coached exercises lecture		problem taking into account various material properties
		loctare		To have some basic understanding on the available possibilities to steer the structure of a material and consequently to design
				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 us
				in specific situations.
)01132 Mathe	ematical 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,
			орен воок ехапіпаціон	improper integral and integral
				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 ini- 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	matics	guided self-study	written examination	To master the structured programming paradigm and to realize a Python program, using this structured programming paradigm
	seminar: practical PC room classes	open book examination	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.	
001222 Mathe	ematical Analysis II	lecture guided self-study	written examination	Being able to perform the chain rules for differentiable functions.
		seminar: coached exercises	open book examination	Being able to carry out co-ordinate transforms in multiple integrals in two and three dimensions.
		lecture: plenary exercises		Being able to compute integrals in two and three dimensions by subsequent integration.
		lecture		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.
000662 Geon	netry and Linear Algebra	guided self-study	written examination open book examination	Having acquired skills in the manipulation of vectors.
01321 Mathe	ematical Analysis III	lecture	written examination	To master the basic theory of curves.
		seminar: coached exercises lecture: plenary exercises		To apply the residue theorem in a variety of situations.
		lecture. Pieriary exercises		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.
076040 Susta	ainable Business Operations	lecture	written examination with open	To have acquired skills in calculations with the nabla operator. Critical, creative thinking and scientific reasoning
070040 04310	amable Business Operations	loctare	questions	Be able to think carefully about social, scientific and ethical problems and possible solutions to these problems
			written examination with multiple	
005020 Apole	ysis of Systems and Signals	lecture	choice questions	To identify systems and signals; to describe them in continuous time and discrete time.
003020 Allaly	ysis of Systems and Signals	seminar: coached exercises	choice questions	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
				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.)
007120 Mode	elling and Control of Dynamic Systems	lecture seminar: coached exercises		Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) is order to obtain

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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. Ficks 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; unde
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.

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Course Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	Teaching methods ggevonden in de studiefiche	Evaluation methods	Course learning outcome
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 material with the desired properties.
E098512 Sustainability, Entrepreneurship and Ethics	project	assignment	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 us in specific situations. 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
E001460 Discrete Mathematics I	guided self-study seminar: coached exercises practicum lecture	written examination open book examination	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. 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.
	10010.10		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	To master the structured programming paradigm and to realize a Python program, using this structured programming paradign 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	written examination	To be able to solve physics problems by applying these laws and concepts.
E045120 Transport Phenomena	lecture lecture seminar: practical PC room classes seminar	participation open book examination	To understand the physical laws and concepts of the covered chapters. 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.

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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.
E007120 Modelling and Control of Dynamic Systems	lecture seminar: coached exercises		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.) Combining the knowledge of several engineering disciplines (electronics, electro-mechanical, physics, chemical engineering) in order to obtain
E078310 Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes seminar	oral examination	mathematical models of physical dynamic systems. 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
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	written examination	A critical usage of algorithms in practical applications using software.
E099141 Engineering Project	seminar: practical PC room classes 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
E078320 Sustainable Use of Materials: Plastics and Derived Materials	lecture seminar	oral examination	Insight into the interactions between molecules and the surface of a solid 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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden 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.
E045120 Transport Phenomena	lecture seminar: practical PC room classes seminar	open book examination	To have acquired skills in calculations with the nabla operator. 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.

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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.
E007120 Modelling and Control of Dynamic Systems	lecture		To describe linear systems by means of the state model. (exclusively for the 6 credit points course.) To evaluate in a correct way the results of computer simulations and numerical techniques when designing feedback
E068660 Polymers	seminar: coached exercises lecture	written examination	control systems. Ability to define and describe preparation methods and polymerisation techniques of (co)polymers, modification reactions,
Loodoo Tolymers		witten examination	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
E066020 Microstructure of Materials	lecture	written examination with open	recycling issues. Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and
	practicum	questions report	ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion
		open book examination	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
E069110 Advanced Fibres and Derived Materials	excursion	oral examination	recrystallization texture. Make the link between the chemical and physical structure of the materials and how these result in specific properties and
	seminar lecture	assignment participation	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
E099040 Cross-Course Project	guided self-study	job performance assessment	Use of Computer Aided Engineering tools such as finite element modelling for specific engineering use cases. Searching, processing and interpreting relevant information in an independent manner and applying this information in the area
•	project lecture	report	of chemical engineering and material sciences
	group work		Translate, while working in a team, an interdisciplinary problem formulation into a concrete research question and address this
	demonstration		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.

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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.

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EBingwALG3.4 Show scientific of the scientifi	•	- 1	Intellectual competence
Course Noot: leer- en evaluatievormen voorafgegaan door ** werden niet tert	Teaching methods	Evaluation methods	Course learning outcome
Noot. leer- en evaluatievormen vooralgegaan door - werden niet tert	iggevonden in de studienche		
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 use 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.)

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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, rucleation 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. Skillis: 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 explain the interplay between the
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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
loot: leer- en evaluatievormen voorafgegaan door ** werden n	iet 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

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	uggevonden 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.

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EBingwCTMA3.2 Be able to critically analyse the own approach for problem solving.

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Intellectual	competence
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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden 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
E021520 Statistical Physics and Molecular Structure	lecture seminar: coached exercises	written examination	Critically evaluating the acquired insights in a social, ethical and economic framework 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.

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Course Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	Teaching methods gevonden in de studiefiche	Evaluation methods	Course learning outcome
E001142 Basic Mathematics	lecture 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.
	lecture: plenary exercises		Being able to make a correct reasoning and to write it down in a structured way.
E070080 Chemical Thermodynamics	guided self-study	written examination	Application of the laws of thermodynamics on chemical systems.
E070000 Chemical memodynamics	seminar: coached exercises		Calculation of the solubility of ionic compounds in aqueous solutions.
	lecture		Calculation of the pH of aqueous solutions.
E002042 Probability and Statistics	guided self-study	written exemination with multiple	Understand and apply chemical equilibrium. To reason and to work with multi-dimensional random variables
E003043 Probability and Statistics	seminar: coached exercises	written examination with multiple choice questions	To perform a linear regression and to interpret its results
	lecture	open book examination	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
E066012 Materials Technology	guided self-study	written examination	To calculate probabilities of events and expectations of random variables To name materials properties and to be able to distinguish between the different groups of materials
2000012 Materials recrimology	seminar: practical PC room classes	Witter examination	To be able to select, by using a material selection software program, the most appropriate material for a specific engineering
	seminar: coached exercises		problem taking into account
	lecture		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 appointing attractions.
E098512 Sustainability, Entrepreneurship and Ethics	lecture	participation	in specific situations. Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the
E096512 Sustainability, Entrepreneurship and Ethics	project		framework of engineering
	L)		activities.
E020061 Physics I	demonstration		To understand the physical laws and concepts of the covered chapters.
FOOM AND	lecture	200	To be able to solve problems by applying these laws and concepts.
E001132 Mathematical Analysis I	guided self-study	written 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 potions of primitive function, integral
	lecture: plenary exercises seminar	open book examination	To have acquired insight in the mathematical, geometric and physical interpretation of notions of primitive function, integral, improper integral and
	lecture		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.
E070070 Chemistry: the Structure of Matter	guided self-study		Being able to use power series for solving ordinary differential equations. Being able to perform stoichiometric calculations.
2070070 Chemistry, the Structure of Matter	seminar: coached exercises		Identify and describe the different types of intermolecular interactions.
	lecture		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
E098513 Modelling, Making and Measuring	project	report	Being able to write the electron configuration of atoms and ions. Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E090515 Modelling, Making and Measuring	project		Oral presentation
			Writing reports
E001222 Mathematical Analysis II	guided self-study	written examination	Being able to perform the chain rules for differentiable functions.
	seminar: coached exercises	open book examination	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.
	lecture: plenary exercises lecture		Having acquired insight in local, absolute and conditional extremum problems, and being able to solve such problems.
	icota.c		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	Having acquired insight in the notions rank, image, kernel, invertability, and determinant of a linear transform.
	lecture: plenary exercises seminar		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
	lecture		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.
F004004 M # # # # # # # # # # # # # # # # # #			Having acquired insight in the mathematical, physical and geometric meaning of eigenvalues and eigenvectors.
E001321 Mathematical Analysis III	lecture	written examination	To master the basic theory of curves. To apply the residue theorem in a variety of situations
	seminar: coached exercises lecture: plenary exercises		To apply the residue theorem in a variety of situations.
	iodiaio. pionary oxoroises		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	written examination	To be able to solve physics problems by applying these laws and concepts.
	lecture	participation	To understand the physical laws and concepts of the covered chapters.
E045120 Transport Phenomena	lecture	open book examination	To understand the properties of fluids.
•	cominar: practical DC room alaccos		To understand the similarities between transport of impulse, heat and mass.
•	seminar: practical PC room classes		
·	seminar		To solve problems of stationary heat transport.
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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,
E066020 Microstructure of Materials	lecture practicum	written examination with open questions report open book examination	Nyquist. 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 ele
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation	emergence of a recrystallization texture. 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.
E099040 Cross-Course Project	guided self-study	job performance assessment	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. Searching, processing and interpreting relevant information in an independent manner and applying this information in the area
	project lecture group work demonstration	report	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.

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Course Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	Teaching methods	Evaluation methods	Course learning outcome
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	Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E078310 Sustainable Use of Materials: Metals	lecture seminar: practical PC room classes	report 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
	seminar		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	written examination with open	Concepts: ideal and regular fixed solutions, chemical potential in fixed phases; thermodynamic approximation of the binary and
	practicum	questions report	ternary state diagrams; order-disorder transformation, anti-phase boundaries; lattice errors and their equilibrium concentration; atomic diffusion
		open book examination	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 connection
			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	oral examination	Make the link between the chemical and physical structure of the materials and how these result in specific properties and
	seminar lecture	assignment	behavior. Obtain knowledge and understanding of advanced fibres / high performance fibres and derived materials.
	lecture	participation	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	job performance assessment report	Searching, processing and interpreting relevant information in an independent manner and applying this information in the area of chemical engineering
	lecture	- F	and material sciences
	group work demonstration		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	oral examination report	understanding the working principle of measuring and analytical equipment develop a critical mindset to procedures, best practices, and guidelines
	project	job performance assessment	oral presentation of obtained results and insights
	lecture	skills test participation	writing compacte but complete reports work accurately with measuring and analytical equipment
E021520 Statistical Physics and Molecular Structure	lecture	written examination	Understand the need for a quantum mechanical description of phenomena at the atomic and molecular scale.
	seminar: coached exercises		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.

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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.

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<<	EBingwALG4.3 Work as part of a t	eam.		Competences in cooperation and communication
Course		Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en	evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche		
E098512 S	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 N	Modelling, Making and Measuring	project	participation report	Concepts: working collaboration in a group, scientific techniques, use of scientific language.
E066020 M	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 marteristics and origin of marteristics and origin of marteristics 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 influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict influence factors on kinetics; recognizing situations where massive transformation occurs; understand the mechanisms during the annealing process. Insights: understanding the structure of fixed solutions in function
	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 C	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 E	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

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	_		
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 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 use 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 terrany 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 connection between the state diagrams and the affinity between the alloying elements; unders
E099040 Cross-Course Project	guided self-study project lecture group work demonstration	job performance assessment report	recrystallization texture. 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

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oral examination

job performance assessment

job performance assessment

report

report

skills test

participation

participation

E099141 Engineering Project

E070310 Organic Chemistry

excursion

practicum

project lecture

seminar: coached exercises

Apply previously acquired knowledge to a (for the concerned student) new problem in the area of chemical engineering and

Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing

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;

Having insight in 3D-structure of organic molecules, being able to make relations between chemical structures and properties of

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

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

able to develop multi-step reaction sequences.

work accurately with measuring and analytical equipment

writing compacte but complete reports

solving capability.

organic molecules; being

E045910 Heat Engineering and Mass Transport

lecture

seminar: coached exercises

written examination

report

simulation participation oral 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. open book examination

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<<	EBingwCTMA4.1 To be able to ap	ply an integrated project app	proach as part of a team.	Competences in cooperation and communication		
Course		Teaching methods	Evaluation methods	Course learning outcome		
Noot: leer- en	evaluatievormen voorafgegaan door ** werden niet terug	ggevonden in de studiefiche				
E098512 S	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 M	Modelling, Making and Measuring	lecture project	participation report	Concepts: working collaboration in a group, scientific techniques, use of scientific language. Oral presentation Writing reports		
E006020 IV	ficrostructure 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 terrary 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, incleation 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 influence factors on kinetics; recognizing situations where massive transformation occurs; understand texture transfer; predict influence factors on kinetics; recognizing situations where massive transformation occurs; 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 betwee		
E099040 C	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 E	ngineering 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		

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EBingwALG5.1 Act in an ethical and social way. Societal competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden 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

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EBingwALG5.2 Be aware of the business aspects of the engineering discipline.

Societal competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden in de studiefiche		
E098512 Sustainability, Entrepreneurship and Ethics	lecture project	assignment	Having a general knowledge about aspects of sustainability, entrepreneurship and ethics, and being able to apply those in the framework of engineering activities.
E076040 Sustainable Business Operations	lecture	written examination with open questions assignment written examination with multiple choice questions	Understand the technique of financial balance sheet reading and be able to apply it practically in simple accounting exercises Mastering the basic concepts of macroeconomics and microeconomy: law of supply and demand, markets (perfect competition monopoly, oligopoly, game lee 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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EBingwCTMA5.1 Be aware of safety and environmental issues in chemical engineering and materials science.

Societal competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden in de studiefiche		
E078310 Sustainable Use of Materials: Metals	lecture oral examination seminar: practical PC room classes		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.
	seminar		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
E071010 Process Engineering	lecture		society. 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	job performance accessment	understanding the working principle of measuring and analytical equipment
	seminar: coached exercises		develop a critical mindset to procedures, best practices, and guidelines
	project		oral presentation of obtained results and insights
	lecture		writing compacte but complete reports work accurately with measuring and analytical equipment
E070310 Organic Chemistry	practicum	participation report	Ability to define and describe in detail reaction mechanisms, knowing relation between chemical structure and reactivity, knowing properties of most
		job performance assessment	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	lecture		Gaining knowledge concerning the fundamentals of sustainable technology and related concepts.
Derived Materials	seminar		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.

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EBingwCTMA5.2 Be aware of public and economic importance of the chemical and materials industry.

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Societal competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden in de studiefiche		
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.

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EBingwCTMA6.1 Identify all sorts of professional situations and fields of activity for engineers in chemical processes and materials science.

EBingwCTMA6.1 Identify all sor	ts of professional situations a	and fields of activity for engi	neers in chemical processes and materials science.	Profession-specific competence	
Course	Teaching methods	Evaluation methods	Course learning outcome		
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet te	eruggevonden in de studiefiche				
E071010 Process Engineering	lecture		Have a basic insight in the different aspects of the exploitation and maintenance Establish the logical links between the different steps of designing, engineering		
E069110 Advanced Fibres and Derived Materials	excursion seminar lecture	oral examination assignment participation			
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 not chemical engineering and material sciences Translate, while working in a team, an interdisciplinary problem formulation into question in a systematic manner Apply previously acquired knowledge to a (for the concerned student) new prob material sciences Reporting and presenting the acquired results and insights in a concise, yet con Critically evaluating the acquired insights in a social, ethical and economic frame	nanner and applying this information in the area a concrete research question and address this lem in the area of chemical engineering and uplete manner	
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 ra To dermine concentration profiles To combine conservation equation and Fick's law for specific applications in che To determine mass fluxes and molar fluxes Analyse and evaluate in a critical and independent manner systems and proces	emical industry	

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