Amtliche Bekanntmachungen der TU Bergakademie Freiberg

Nr. 1, Heft 2 vom 21. Februar 2017

Modulhandbuch

für den

Masterstudiengang

Sustainable and Innovative Natural Resource Management (SINReM)

Inhaltsverzeichnis

Abkürzungen

KA: schriftliche Klausur / written exam
MP: mündliche Prüfung / oral examination
AP: alternative Prüfungsleistung / alternative examination
PVL: Prüfungsvorleistung / prerequisite
MP/KA: mündliche oder schriftliche Prüfungsleistung (abhängig von Teilnehmerzahl) / written or oral examination (dependent on number of students)

SS, SoSe: Sommersemester / sommer semester
WS, WiSe: Wintersemester / winter semester

SX: Lehrveranstaltung in Semester X des Moduls / lecture in module semester x

SWS: Semesterwochenstunden

Data:	BCEPE. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Basics of Control Engineering and Process Engineering**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Volcke, Eveline / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	The student is able to interpret a control problem and to translate it into a block scheme. He knows how to choose an appropriate type of controller and to tune it. He has insight in the dynamics of linear systems, both in open and closed loop. The student is capable of interpreting the technical description of an industrial installation and can estimate the requirements which a technical installation has to meet.		
Contents:	Control engineering 1. Introduction 1. Aim of process control 2. Terminology 2. Dynamic behaviour of linear systems 1. First order systems 2. Second order systems 3. Higher order systems 3. Feedback control 1. Principle – examples 2. Controller types 3. Open-loop versus closed-loop dynamics 4. Controller selection and tuning 1. Controller design problem 2. Performance criteria 3. Controller type selection 4. Controller tuning Process engineering 1. Heating and cooling 1. Basics of thermodynamic cycles 2. Heating technology (steam cycle, heat pumps) 3. Cooling technology (reverse Carnot cycle, vapor compression and absorption cooling systems) 2. Transport systems 1. Liquid transport (hydraulic systems, pumps and valves) 2. Gas transport (fans, blowers and compressors) 3. Introduction to heat engines 1. External combustion engines: Brayton, Sterling and Rankine cycle based 2. Internal combustion engines: Diesel & Otto cycle based		
Literature:	Stephanopoulos G. (1984). Chemical process control, an introduction to theory and practice. Prentice-Hall Englewood Cliffs, USA, ISBN 0-13-128629-3		
Types of Teaching:	S1 (WS): plenary exercises 6.25 h, lecture 10.0 h / Lectures (1,08 SWS) S1 (WS): practical PC room classes 12.5 h, coached exercises 11.25 h / Seminar (1,58 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge of physical transport phenomena (mass and heat		

	balances)
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 7] AP*: Assignments [w: 3] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 120h. It is the result of 39.9h attendance and 80.1h self-studies.

Data:	BNANO. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2018
Module Name:	**Basics of Nanotechnology**		
(English):			
Responsible:	Joseph, Yvonne / Prof. Dr. rer. nat.		
Lecturer(s):	Joseph, Yvonne / Prof. Dr. rer. nat.		
Institute(s):	Institute of Electronic and Sensor Materials		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to: • Insights in the different (technological) options for optimizing resource flows in the different parts of the value chain and be able to compare them, taking technical and economic aspects as well as social and environmental impact into account. • Consult specialist literature and interpret it critically according to scientific standards. • Understand the complexity of a problem/system using quantitative methods. • Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process.		
Contents:	Definition, history and applications of nanotechnology; By using selected examples, the basic effects in nanotechnology are demonstrated: Structural differences (lattice constants, tunneling processes, defects), influence of the large surfaces relative to the volume (adsorption, catalysis), analytics, influencechnological) options for optimizing resource flows in the different parts of the value chain and be able to compare them, taking technical and economic aspects as well as social and environmental impact into account. Consult specialist literature and interpret it critically according to scientific standards. Understand the complexity of a problem/system using quantitative methods. Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process. of quantization (optical and magnetic properties), toxicity of nanomaterials		
Literature:	H.-J. Butt, K. Graf, M. Kappl, Physics and Chemistry of Interfaces,Wiley-VCH, 2008, ISBN: 978-3-527-40629-6, G.L. Hornyak, J. Dutta, H. F. Tibbals, A. K. Rao, Introduction to Nanoscience, CRC press, 2008, ISBN: 978-1-4200-4805-6, G. Cao, Nanostructures &Nanomaterials, Imperial College Press, 2006, ISBN: 1-86094-415-9		
Types of Teaching:	S1 (SS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Bachelor-degree in engineering or applied science or in another area of science or engineering.		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]		

Credit Points:	3
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	BSEN. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Biosensors**		
(English):			
Responsible:	Joseph, Yvonne / Prof. Dr. rer. nat.		
Lecturer(s):	Joseph, Yvonne / Prof. Dr. rer. nat.		
Institute(s):	Institute of Electronic and Sensor Materials		
Duration:	1 Semester(s)		
Competencies:	• Apply techniques for qualitative and quantitative exploration and physicochemical characterization of resources present in the environment, including spatial and temporal variability. • Apply techniques to assess environmental impacts of products and processes. • Insight in the different (technological) options for optimizing resource flows in the different parts of the value chain and be able to compare them, taking technical and economic aspects as well as social and environmental impact into account. • Consult specialist literature and interpret it critically according to scientific standards. • Understand the complexity of a problem/system using quantitative methods. • Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process. • Entrepreneurial mindset to develop new ideas within a multidisciplinary context.		
Contents:	Physiology of human sensoric (skin , eye, ear , nose , tongue) and actuator (muscles , vocal cords) system , information processing in humans (neurophysiology , cells , ion channels , action potentials , patch - clamp technique, bio - computing) ; Structure and Principle of biosensors and bio-analytical tests (including ELISA) : bioreceptors (proteins , enzymes, antibodies , DNA, RNA , aptamers , cell , animal antennas) , as well as immobilization of bioreceptors suitable transducers for biosensors; Structure and principle of bioactuators ; microfluidic systems , lab - on-a - chip systems ; Applications of biosensors (eg. glucose sensors , pregnancy tests , drug tests) and bioactuators		
Literature:	Gorton, L: Biosensors and modern biospecific analytical techniques, (ISBN 978-0-444-50715-0);		
Types of Teaching:	S1 (WS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Bachelor-degree in engineering or applied science or in another area of science or engineering.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		

Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	BIOMIN. MA. Nr. 3043 / Examination number: -	Version: 25.09.2009	Start Year: SoSe 2010
Module Name:	**Biotechnology in Mining**		
(English):			
Responsible:	Schlömann, Michael / Prof. Dr.		
Lecturer(s):	Schlömann, Michael / Prof. Dr. Mühling, Martin / Dr.		
Institute(s):	Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The students will obtain knowledge about mechanisms of microbial leaching as about applications for the production of metals. They will understand problems related to mine waters and obtain insight into strategies for biotechnological treatment of such waters. In a lab course they will obtain experience with methods and problems related to the cultivation of corresponding microorganisms. In a seminar the students will gain experience with current literature and with reporting about it to other participants.		
Contents:	1. Basics Concepts of microbial energy metabolism, chemolithotrophic growth, diversity of electron acceptors, microbial redox reactions with sulphur, iron, manganese, arsenic, uranium. 2. Microbial leaching Mechanisms of leaching, microorganisms involved, application of leaching for the production of copper, gold and diamonds, problem of mine waters. 3. Biotechnological treatment of mine waters Microbial sulphate reduction for active treatment, microbial iron oxidation, wet lands. 4. Lab course Special plating techniques for acidophilic bacteria, anaerobic cultivation techniques, measurement of parameters to follow growth of relevant microorganisms.		
Literature:	W. Reineke & M. Schlömann: Umweltmikrobiologie, Spektrum Akademischer Verlag; D. R. Lovley (Hrsg.): Environmental Microbe-Metal Interactions, ASM Press; D. E. Rawlings & D. B. Johnson (Hrsg.): Biomining, Springer; L. L. Barton & W. A. Hamilton: Sulfate –Reducing bacteria Environmental and Engineered Systems, Cambridge University Press		
Types of Teaching:	S1 (SS): Lectures (1 SWS) S1 (SS): Seminar (1 SWS) S1 (SS): Practical Application (1 SWS) S1 (SS): Excursion (0,5 SWS)		
Pre-requisites:	**Recommendations:** Master-degree applied science and geoecology or in another area of science or engineering.		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] PVL: Passed exercises PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min]		

	PVL: Übungsaufgaben PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 120h. It is the result of 52.5h attendance and 67.5h self-studies.

Data:	CMRR. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Chemical Modification of Renewable Resources**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Mangelinckx, Sven / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Students have insight and knowledge about the conntectivity and the multidisciplenary character of the teached subjects.		
Contents:	1. Possibilities and driving forces for the use of agricultural raw materials 2. Use of vegetable and animal oils and fats in industrial applications 3. Applications of saccharides for non-food applications: starch, cellulose, sugar, fructans, ... 4. Use of proteins in industrial applications 5. Fibers (for use in composite materials) 6. Wood 7. Energy: bio-ethanol, biodiesel 8. Green chemistry		
Literature:	W.G.J. Brouwer : Plantaardige grondstoffen voor de industrie, Samson (1991) C. V. Stevens, R. Verhé : Renewable Bioresources, Scope and Modification for Non-Food Applications, Wiley, London (2004) (ISBN : 0-470-85447-2)		
Types of Teaching:	S1 (SS): 23.75h / Lectures (1,58 SWS) S1 (SS): guided self-study 6.25h / Seminar (0,42 SWS)		
Pre-requisites:	**Recommendations:** Succesfully having followed courses of 'Organic chemistry - structure' and 'Organic chemistry - reactivity' or having acquired the herein targeted competences in an other manner		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 to 240 min] Class attendance is required.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 bis 240 min] Anwesenheit ist erforderlich.		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.		

Data:	CHSEN. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Chemical Sensors**		
(English):			
Responsible:	Joseph, Yvonne / Prof. Dr. rer. nat.		
Lecturer(s):	Joseph, Yvonne / Prof. Dr. rer. nat.		
Institute(s):	Institute of Electronic and Sensor Materials		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to: • Apply techniques for qualitative and quantitative exploration and physicochemical characterization of resources present in the environment, including spatial and temporal variability. • Apply techniques to assess environmental impacts of products and processes. • Insight in the different (technological) options for optimizing resource flows in the different parts of the value chain and be able to compare them, taking technical and economic aspects as well as social and environmental impact into account. • Consult specialist literature and interpret it critically according to scientific standards. • Understand the complexity of a problem/system using quantitative methods. • Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process. • Entrepreneurial mindset to develop new ideas within a multidisciplinary context.		
Contents:	In the module the physico-chemical principles (kinetics and thermodynamics of adsorption, adsorption isotherms, surface chemistry, electrochemistry) will be provided. Important chemisensitive materials (e.g. zeolites, metal oxides, polymers, composites, host-guest compounds) and the operating principles of chemical sensors (infrared sensors, potentiometry, amperometry, Conductometry, coulometry, calorimetry, etc.) in their applications will be explained. Particularly the relationship between the structures of the sensor materials, the physico-chemical properties and the resulting applications are emphasized. The use of chemical sensors in complex systems (electronic noses, Cyber-chemical systems, etc.) is shown, and selected aspects of the systems (eg. B. fluidics, sample preparation, data analysis) will be discussed.		
Literature:	Peter Gründler, Chemical Sensors, Springer, 2007, ISBN: 9783540457435;Jiri Janata, Principles of chemical Sensors, Springer 2009, ISBN:978-0-387-69930-1; Hans-Jürgen Butt et al.: Physics and chemistry of interfaces, Wiley-VCH, 2011, ISBN 3-527-40629-8; Vladimir M. Mirsky: Artificial receptors for chemical sensors, Wiley-VCH, 2011, ISBN 978-3-527-32357-9		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Bachelor-degree in engineering or applied science or in another area of science or engineering.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains:		

	MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min]
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Data:	CTEC. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Clean Technology**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	De Meester, Steven / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Understanding how resource consumption and selection, process efficiency and emission patterns affect the contribution of technology to environmental sustainability. Also the importance of technology within industrial society has to be understood.		
Contents:	1. Technology & sustainability 2. Effects of technology on the environment 3. Changing technology through new concepts ◦ Clean technology ◦ Eco management and audit scheme ◦ Industrial ecology 4. Changing technology at the process design ◦ Green chemistry ◦ Polution prevention at the unit operations 5. Changing technology through process Integration 6. Assessing technology through LCA en EF 7. Assessing technology through input/output analysis 8. Assessing technology through exergy analysis		
Literature:	Anastas P.T. and Warner J.C. (1998) Green Chemistry: Theory and Practice. Oxford University Press, New York, 135p Graedel T.E. and Allenby B.R. (1996) Design for Environment. Prentice Hall, New Jersey, 175p Johansson A. (1992) Clean technology. Lewis Publishers, Boca Raton, 196p Lowe E.A., Warren J.L. and Moran S.R. (1997) Discovering industrial ecology - An executive briefing and sourcebook. Battelle Press, Columbus, 191p Kotas T.J., The exergy method of thermal plant analysis, Butterwoods, London, 1985, 296p Moran M.J., Availability analysis, a guide to efficient energy use, corrected edition, The American Society of Mechanical Engineers, New York, 1989, 260p		
Types of Teaching:	S1 (WS): 23,75h / Lectures (1,58 SWS) S1 (WS): guided self-study 8.75h, group work 3.75, integration seminar 5.0h, self-reliant study activities 8.75h, coached exercises 10.0h / Seminar (2,42 SWS)		
Pre-requisites:	**Recommendations:** There are no specific requirements.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen		

	der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 13] AP*: permanent evaluation/assignments [w: 7] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	COMP. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Composites**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Degrieck, Joris / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Students have insight in the technology, the basic mechanics, and some specific aspects of fibre reinforced materials.		
Contents:	• Technology of fibre reinforced materials: Fibre reinforced composites: introduction, Review of reinforcing fibres and matrices, Properties and applications, Fabrication processes, Sandwich constructions • Stiffness and strength: Micromechanics of a layer, Macromechanics of a layer, Classical laminate theory, Interlaminar stresses • Mechanical behaviour and testing of fibre reinforced plastics: Fracture and damage mechanics, Fatigue, Impact, Static testing, Non-destructive testing • Design aspects		
Literature:	not available		
Types of Teaching:	S1 (WS): 30h / Lectures (2 SWS) S1 (WS): practical PC room classes 15.0h, practicum 15.0h / Seminar (2 SWS)		
Pre-requisites:	**Recommendations:** Mechanics of Materials, Basic Material Science		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP: Including written preparation [30 to 60 min] Class attendance is required.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP: Incl.schriftlicher Vorbereitung [30 bis 60 min] Anwesenheit ist erforderlich.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP: Including written preparation [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.		

Data:	CSTEC. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Corrosion and Surface Technology**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Verbeken, Kim / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	NOTIONS: Corrosion, surface properties, surface treatment, thermal oxidation INSIGHTS: Fundamental understanding of corrosion and corrosion control. Insights in the enormous possible applications of surface techniques with special emphasis on their properties. SKILLS: Justified material choice taking into account the environment in which the material is used. Choosing the most appropriate surface treatment technique.		
Contents:	Corrosion: Basic theory and electrochemical corrosion, Metallurgical cells, Environmental cells, Corrosive-mechanical interactions, Corrosion in some important environments, Materials selection, Cathodic and anodic protection, Corrosion inhibitors, Corrosion tests, Corrosion and design Thermal oxidation: Thermodynamics and kinetics, Oxidation control by alloying and coatings Surface technology: Objectives of surface treatments and introduction to surface related properties of metals and the concepts of the full surface processing, illustrated for industrial applications; Mechanisms, properties and applications for the following surface treatments are discussed, including technological and ecological issues Electrochemical conversion: Chromate conversion, zirconium-titanium conversion, phosphating Chemical deposition/passivation: Silane coatings, self-healing coatings, plasma coatings, including hybrid layers Electrolytic conversion: Anodising, electrolytic colouring Metal deposition: Electroplating (Cr, Sn, Ni, ...), (electroless) plating, galvanizing, aluminizing.		
Literature:	Corrosion Engineering Handbook, P.A. Schweitzer		
Types of Teaching:	S1 (SS): 30.0h / Lectures (2 SWS) S1 (SS): 30.0h / Seminar (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge of chemistry and physics		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] MP*: Including written preparation [30 to 60 min] Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] MP*: Incl.schriftlicher Vorbereitung [30 bis 60 min] Anwesenheit ist erforderlich.		

	* Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 1] MP*: Including written preparation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.

Data:	CMM. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Critical Metals and Minerals**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Jonsson, Erik		
Institute(s):	University Uppsala		
Duration:	1 Semester(s)		
Competencies:	After completion of the course, the student should be able to: • Examine the concept of criticality, the background of critical metals and minerals and the parameters that govern their classification. • Describe key metallogenetic processes responsible for the formation of deposits of critical metals, and their mineral hosts. • Evaluate constraints on mineral supply responses.		
Contents:	This course provides an overview of the principles of classification and assessment of critical metals and minerals and their application globally and specifically within the EU. The concept of “Peak metal” will feature. The supply of critical metals and minerals will be discussed. The metallogenetic context of present and near-future deposit types for critical metals and minerals. The mineralogy of critical metals, substitution and recycling issues will be covered. Practicals will illustrate critical metal-mineralised systems. Individual student projects are focused on certain types of critical metal and mineral deposits, their character and origin, and include evaluating their present and future potential.		
Literature:			
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Bachelor-degree in engineering or applied science or in another area of science or engineering.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written project AP*: Presentation of the individual project, individual student activity/feedback during seminar and discussion sessions. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Projektarbeit AP*: Präsentation der Projektarbeit, individuelle Mitarbeit/ aktive Teilnahme am Seminar und der Diskussion. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written project [w: 1]		

	AP*: Presentation of the individual project, individual student activity/feedback during seminar and discussion sessions. [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.

Data:	DVENT. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Dare to Venture**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Clarysse, Bart / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Students have to develop in group a “business case” concerning the commercialisation of a new technology. The models and structure discussed in the course are therefore a necessity. They have to present the project at the end of the course. They have to submit a business plan.		
Contents:	The course includes the following modules: 1. Creativity: ◦ 6-stage creativity and problem solving tool, Technology application matrices, Prioritizing technology/applications ◦ Workshop 1: Idea Pitch 2. Appropriability and Freedom to Operate: ◦ Determine a protection strategy (based upon patents, copyrights, trademarks...), Analyse Freedom to Operate 3. Prototyping and Innovation Tools: ◦ Conceptual Models, Industrial Design Prototypes, Development Prototypes, Alpha prototypes, Beta prototypes, Pre-production prototypes 4. Value Chain, Value Network and Complementary Assets: ◦ Determine the position in the Value Chain, Value Added Network – ecosystems of technological solutions, Example Mobixx, Push and Pull strategies ◦ Workshop 2: Value Proposition 5. Market Assumptions: ◦ Market size, Market Segmentation Techniques, Identification of Market Needs, Examine Go to Market Possibilities, Create a market “pull” 6. Sources of Finance and Valuation ◦ Financing Mix, Sources of Finance, Valuation of New Technologies, Net Present Value, Relative Valuation, Real Options, Logic Valuation 7. Market Introduction: ◦ Sales Team, Composition, Team Management, Organisation and structure Sales objectives, Modalities, Processes, Sales Plan ◦ Workshop 3: Market Test assumption 8. Commercialisation via Venture: ◦ Shareholders Agreement, Technology, Capital, Founder and Management Shares, Dilution, Rights associated with shares, Board of Directors, Negotiation Exercise ◦ Workshop 4: Presenting Financial Plan and Roadmap		
Literature:	The handbook for the course is “The Smart Entrepreneur: A roadmap to Success” by Clarysse and Kiefer (2011) (price: 15 euro).		
Types of Teaching:	S1 (SS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge of entrepreneurship is required. Technology interest is a necessity.		

Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA*: Multiple choice exam - closed book [120 to 240 min] AP*: Project report, final presentation Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA*: Multiple Choice Test [120 bis 240 min] AP*: Projektarbeit mit Präsentation Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA*: Multiple choice exam - closed book [w: 1] AP*: Project report, final presentation [w: 3] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 120h. It is the result of 30h attendance and 90h self-studies.

Data:	ENVAS. MA. Nr. / Examination number: -	Version: 11.01.2016	Start Year: SoSe 2017
Module Name:	**Environmental Assessment**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Bishop, Kevin / Dr.		
Institute(s):	University Uppsala		
Duration:	1 Semester(s)		
Competencies:	After completion of the course, the student should be able to: • describe the decision-making process with regard to environmental issues in the context of sustainable development • apply the environmental assessment cycle approach in identifying and resolving environmental problems • analyze the evaluation criteria used in environmental decision-making using available environmental data • evaluate the suitability of different approaches to decision support that provide strategies for addressing environmental problems and related societal issues, with an analysis of advantages and disadvantages from a multidisciplinary perspective.		
Contents:	• Basic theory of science and methodology. • The environmental assessment cycle as an organizing principle for identifying environmental issues, suggesting different ways to address the issues, and following up progress towards those issues. • Introduction to assessment methodologies including cost-benefit analyses and environmental quality criteria. • Examples related to water and energy will be used. Students will conduct their own analysis of an issue and present it to their peers. • Basic theory of science and methodology. • The environmental assessment cycle as an organizing principle for identifying environmental issues, suggesting different ways to address the issues, and following up progress towards those issues. • Introduction to assessment methodologies including cost-benefit analyses and environmental quality criteria. • Examples related to water and energy will be used. Students will conduct their own analysis of an issue and present it to their peers. • Basic theory of science and methodology. • The environmental assessment cycle as an organizing principle for identifying environmental issues, suggesting different ways to address the issues, and following up progress towards those issues. • Introduction to assessment methodologies including cost-benefit analyses and environmental quality criteria. • Examples related to water and energy will be used. Students will conduct their own analysis of an issue and present it to		

	their peers.
Literature:	instructions will be given.
Types of Teaching:	S1 (SS): Lectures / Lectures (3 SWS) S1 (SS): Project work and literature study / research project
Pre-requisites:	
Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written report on project AP*: Oral report on project, individual student activity/feedback during seminar and discussion sessions. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Projektarbeit AP*: Präsentation zum Projekt, individuelle Mitarbeit/ aktive Teilnahme am Seminar und der Diskussion. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written report on project [w: 1] AP*: Oral report on project, individual student activity/feedback during seminar and discussion sessions. [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.

Data:	ENVC. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Environmental Constructions**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Volcke, Eveline / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	After successfully completing this course the student will be able to judge a technical description of an environmental installation and to some extent be able to design an installation of limited scale.		
Contents:	1. Introduction to design – process diagrams 2. Wastewater treatment ◦ Design for COD and N removal ◦ Process control and instrumentation 3. Air treatment 4. Installations for the removal of dust, NH_3, NO_X, ... 5. Solid waste treatment 6. Design and automation of thermal and biological treatment units 7. Design of an environmental installation Coached exercises, PC room classes and group work concerning the design of (part of) an installation for waste, off-gas or waste treatment.		
Literature:	Henze M., van Loosdrecht M.C.M., Ekama G. and Brdjanovic D. (Eds.) (2008). Biological wastewater treatment. Principles, modelling and design. IWA publishing, London, U.K, 512 p. Qasim S.R. (1999) Wastewater treatment plants. Planning, design and operation. 2nd edition, CRC press. Olsson G., Nielsen M. K., Yuan Z., Lynggaard-Jensen A. and Steyer J.-P. (2005). Instrumentation, Control and Automation in Wastewater Systems. IWA Scientific and Technical Report no. 15. IWA Publishing, London, U.K, 246 p. Tchobanogous G., Theisen H. en Vigil S.A. (1993). Integrated solid waste management. Engineering principles and management issues. McGraw-Hill, Inc., 976 p.		
Types of Teaching:	S1 (WS): 23.75 h / Lectures (1,58 SWS) S1 (WS): excursion 3.75 h, practical PC room classes 6.25 h, group work 7.5 h, guided self-study 10.0 h, coached exercises 8.75 h / Seminar (2,42 SWS)		
Pre-requisites:	**Recommendations:** Successful completion of the courses Physical transport phenomena, Process engineering		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:		

	KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 4] AP*: Permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	EFMHM. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Environmental Fate and Management of Heavy Metals and Metalloids**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Tack, Filip / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	The students must understand and be able to evaluate behaviour and reactions of heavy metals and metalloids in natural and polluted ecosystems. They should be able to select and apply appropriate remediation and management techniques for metal-polluted soil, sediments and water.		
Contents:	1. Heavy metals and metalloids: environmental chemistry, general principles and processes 2. Assessment of baseline concentrations in soils - legislation 3. Uptake by plants 4. Physicochemical remediation techniques for metal-polluted water, sediments and soil 5. In situ management of heavy metals and metalloids in floodplains and river sediments 6. Phytomanagement 7. Environmental effects of mining activities and sustainable management of metal resources 8. Arsenic in the environment 9. Mercury in the environment 10. Cadmium in the environment		
Literature:	not available		
Types of Teaching:	S1 (WS): 25.0 h / Lectures (1,67 SWS) S1 (WS): group work 5.0 h, guided self-study 5.0 h, practicum 20.0 h, microteaching 5.0 h / Seminar (2,33 SWS)		
Pre-requisites:	**Recommendations:** General knowledge of chemistry and soil science.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w):		

	KA* [w: 4] AP*: permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	ENVIT. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Environmental Inventory Techniques**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Van Meirvenne, Marc / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	In the end of this modules students should be able to • design and lay out a spatial sampling scheme • perform a soil sampling • use several proximal soil sensors and know their limitations • process data into usable maps		
Contents:	This course focuses on the techniques for the inventory of the spatial variability of the environment (with a main focus on soil and water). Also the detection and evaluation of (anthropogene) disturbances are being considered.		
Literature:	Title: Fiel Sampling for Environmental Science Management Authors: Richard Webster and Murray Lark Publisher: Routledge Year: 2013 ISBN: 978-1-84971- 368-9		
Types of Teaching:	S1 (WS): 15.0 h / Lectures (1 SWS) S1 (WS): group work 20.0 h, self-reliant study activities 10.0 h / Seminar (2 SWS)		
Pre-requisites:	**Recommendations:** basic knowledge of statistics, physics and Earth Science		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 4] AP*: Permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Workload:	The workload is 90h. It is the result of 45h attendance and 45h self-		

	studies.

Data:	ENVL. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Environmental Legislation**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Maes, Frank / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	- Having insight into international environmental law and its developments - Know the historical background of international environmental law - Are able to identify the political and inter-state elements/actors that influence international environmental law - Are able to valuate, analyse and assess the impact of the respective political and inter-state elements/actors that influence international environmental law - Are able to analyse and valuate legal texts and sources in the field of international environmental law - Are able to apply the involved rules and regulations to specific cases - Are able to argue potential solutions for a given environmental problem		
Contents:	**Theory** The first part is a general introduction, in particular the position of international environmental law within the broader framework of international public law and its development. Following topics are dealt with: sources and development of international environmental law, governmental organisations and ngo's involved, international environmental conferences, the interaction between universal-regional approaches, the status of territory, sea, air and space in international law, the status of natural resources in international law (common heritage of mankind, common concern, ...). A second part is dedicated to the general principles of international environmental law (prevention of pollution/damage, state sovereignty over natural resources, precautionary principle, polluter pays principle, sustainable development, common but differentiated responsibilities, principles of co-operation, ...). Focus is mainly on prevention and reduction of transboundary pollution and sustainable management of natural resources. Furthermore attention is paid to: implementation deficit, compliance regimes, financing through GEF, governance of MEAs and exploitation vs. protection of natural resources. A third part concentrates on specific rules implementing the general principles related to the protection of oceans and seas, transboundary river pollution and river management, tranboundary air pollution, protection of the ozone layer, climate change, international transport of dangerous waste, environmental impact assessment, public participation, procedural obligations (information supply, consultation, conflict resolution) and sustainable management of natural resources. **Microteaching** Application of the above mentioned principles and rules related to a particular environmental problem chosen by the student, to be prepared by each student in a paper (max. +/- 20 pages). There is also a list of topics available on Minerva Each paper has to be presented by the students and will be discussed in the classroom.		
Literature:	KISS, A. & SHELTON, D., International Environmental Law, Second Ed.,		

	New York, Transnational Publishers Inc., 2000 MORRISON, F. & WOLFRUM, R. (Eds.), International, Regional and National Environmental Law, The Hague, Kluwer Law International, 2000 HUNTER, D., SALZMAN, J. & ZAELKE, D., International Environmental Law and Policy, New York Foundation Press, 2002 + updates SANDS, Ph., Principles of International Environmental Law, Second Ed., Cambridge, Cambridge University Press, 2003 LOUKA, E., International Environmental Law. Fairness, Effectiveness, and World Order, Cambridge, Cambridge University Press, 2006 + web pages environmental organisations : www.unep.org, www.unfccc.org, www.unece.org, ...
Types of Teaching:	S1 (WS): 15.0 h / Lectures (1 SWS) S1 (WS): 15.0 h / Seminar (1 SWS)
Pre-requisites:	**Recommendations:** Are able to distinguish the essentials from the side issues. Have the attitude to be willing to develop a critical and scientific attitude.
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Permanent evaluation/assignments Class attendence is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	3
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 1] AP*: Permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	EEGEO. MA. Nr. / Examination number: -	Version: 11.01.2016	Start Year: WiSe 2017
Module Name:	**Exploration and Environmental Geophysics**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Malehmir, Alireza		
Institute(s):	University Uppsala		
Duration:	1 Semester(s)		
Competencies:	After successful completion of the course the student should be able to: • Explain the physical principles governing the propagation of seismic waves, describe and apply the principles of seismic data acquisition and have a broad understanding of the instruments used in the field. • Interpret a seismic section and identify different seismic phases. • Describe the basic processing steps of reflection seismic data. • Derive a model of the subsurface based on refraction seismic data. • Be able to make gravity measurements and calculate Free-air and Bouguer anomalies and interpret gravity data. • Describe the common types of magnetization, understand how a Proton and a Cesium Vapour magnetometer works, and interpret magnetic data. • Describe the different electrical and electromagnetic methods and how they relate to electrical conductivity and dielectric permitivity. • Compare different geophysical methods, describe their weaknesses, strengths, and applicability to different problems and geological environments.		
Contents:	The seismic reflection method, the seismic refraction method, gravity measurements, magnetization and magnetic measurements, electrical methods, electromagnetic methods including ground penetrating radar, radiometric methods, borehole logging, petrophysics, geophysical field techniques, geophysical modelling and interpretation, field course.		
Literature:			
Types of Teaching:	S1 (WS): lectures / Lectures (3 SWS) S1 (WS): Incl. computer exercises and a compulsory field course / Exercises (3 SWS) S1 (WS): Seminar (3 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* AP*: Report on computer exercises AP*: Report on compulsory field course * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* AP*: Beleg zur Computerübung AP*: Beleg zur Feldstudie		

	* Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	15
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 7] AP*: Report on computer exercises [w: 5] AP*: Report on compulsory field course [w: 3] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 450h. It is the result of 135h attendance and 315h self-studies.

Data:	GEOEX. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2017
Module Name:	**Georesource Exploration and Characterisation**		
(English):			
Responsible:	Tischler, Dirk / Dr.		
Lecturer(s):	Barker, Abigail		
Institute(s):	University Uppsala Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to: • Describe the natural form and occurrence of resources in Earths crust. • Explain the processes of formation of different ore deposit types. • Describe geological and geochemical methods of exploration. • Discuss the economics of natural resources and importance of resources for society.		
Contents:	This course will present the characteristics of natural resources and their formation. Exploration will be approached from geological and geochemical perspectives. Geological exploration will focus on host rocks, alteration and geological structures of ore deposits. Geochemical exploration will cover till, soil and stream geochemistry, as well as alteration vectors. Aspects of economic geology and resource use will be integrated throughout the course.		
Literature:			
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Seminar (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* AP*: Seminar presentation * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* AP*: Präsentation * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 1] AP*: Seminar presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.		

Data:	HYDMETS. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Hydrometallurgical Winning and Refining of Metals**		
(English):			
Responsible:	Stelter, Michael / Prof. Dr.-Ing.		
Lecturer(s):	Stelter, Michael / Prof. Dr.-Ing.		
Institute(s):	Institute for Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to • explainhydrometallurgical processes for the refining and winning of metals**,** properties of the processes and possibilities to win pure metals from purified solutions • distinguish the ways of purification and give insights into metal refining processes • analyse important technical parameters for the refining process interpret the behavior of contaminations in the anode and the hydrometallurgical refining mechanisms.		
Contents:	1. Metal winning processes ◦ Composition of typical electrolytes and the influence of various parameters (T, pH, metal concentrations, contaminations etc.) on metal production. ◦ Processing of electrolytes (heap-leaching, bio-leaching, in-situ-leaching) Strategies for purification of electrolytes before metal winning. 2. Metal refining processes ◦ Electrolytic refining mechanisms, influence of various additives on crystallization of metals, recovery of tramp metals in copper metallurgy (As, Sb, Bi, Se, PGM, Ag Au), ◦ typical methods for regeneration of spent electrolyte, ◦ industrial concepts for hydrometallurgical processes and electrolysis. 3. Lab course ◦ Typical methods of electrolytic winning and refining processes in laboratory scale, ◦ influence of additives in electrolytic metal winning and refining.		
Literature:	F. Habashi: Textbook of Hydrometallurgy , Quebec 1999, F. Pawlek: Metallhüttenkunde, de Gruyter Verlag, Berlin 1983, G. Kortüm: Lehrbuch der Elektrochemie, Verlag Chemie 1972, A. Strauch: Galvanotechnisches Fachwissen, DVG Leipzig 1990		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Practical Application (1 SWS) S1 (WS): Excursion (0,5 SWS)		
Pre-requisites:	**Recommendations:** Knowledge in electrochemical processes, bachelor in chemistry, natural science or other relevant areas.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [60 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [60 min]		

Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 150h. It is the result of 52.5h attendance and 97.5h self-studies.

Data:	IMEI. MA. Nr. / Examination number: -	Version: 12.01.2016	Start Year: SoSe 2016
Module Name:	**Innovation Management, Enterpreneurship and IPR**		
(English):			
Responsible:	Tischler, Dirk / Dr.		
Lecturer(s):	Lindström, Göran Lindström, Göran		
Institute(s):	University Uppsala Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The course is designed as a short, but intensive, introduction and team-building series of seminars, which serves as an introduction to the second year of study in the MSc SINREM. It is designed around the solving of a real-world problem provided by partner firms. The overall goal of the course is to give the student a realistic view of realities, problems and opportunties facing an established company as well as a good understanding of the challenges of group work and cooperating with people with different backgrounds and competencies. In addition the student should get a first insight in the importance of using robust methodology when solving real world problems. In accordance, the student will acquire a basic understanding of scientific methods. More specifically the learning outcomes are: After completing the course, the student should be able to: analyse a complex problem describe basic project design describe innovation and entrepreneurship essentials Perform project planning and project management basics make an overview of scientific methods define problem characteristics and the choice of methods describe how group dynamics and group thinking wotk describe IQ and emotional intelligence master basic presentation techniques and rhetoric		
Contents:	The course is built upon projects presented by participating firms or provided by the students themselves. The nature of the projects are either a well defined technical problem or something related to markets or customer environments. Projects that are proposed by students will have to be cleared by examiners before accepted. The scopes of the projects are limited to something that is possible to solve within a three-week period. Students are organized in groups of 4 individuals (maximum) which are supervised by one mentor from industry and one mentor from academy. Work are organized in seminar sessions with reporting and discussion sessions following each learning topic. The groups are assigned problem-issues to solve to the next seminar session. The course ends with a one-day seminar/conference where projects are presented and discussed and all companies and academic representatives are present.		
Literature:	Schilling Melissa A. Strategic management of technological innovation 3. ed.: Boston: McGraw-Hill/Irwin, cop. 2010		
Types of Teaching:	S1 (SS): Seminar sessions with teachers and company representatives present / Seminar (3 SWS) S1 (SS): Group work for case study / project (3 SWS)		
Pre-requisites:			

Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written Report AP*: Oral Report * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Projektarbeit AP*: Präsentation * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	10
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written Report [w: 1] AP*: Oral Report [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 300h. It is the result of 90h attendance and 210h self-studies.

Data:	EMSR. MA. Nr. / Examination number: -	Version: 11.01.2016	Start Year: WiSe 2016
Module Name:	**Introduction to the Circular Economy, Economics and Management of Natural Resources**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Speelman, Stijn / Dr.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	• Having knowledge of used principles, models and management skills for the circular economy and an optimal use of natural resources. • Being able to present, propose and analyse contemporary problems of natural resource management • Being able to analyse and propose environmental policy instruments • Being able to discuss and analyse possible solutions of pollution problems		
Contents:	1. FOUNDATIONS ◦ An introduction to principals of circular economy, natural resource and environmental economics ◦ The origins of the sustainability problem ◦ Ethics, welfare economics and the environment ◦ Concepts of sustainability ◦ Welfare economics and the environment 2. ENVIRONMENTAL POLLUTION ◦ Pollution control: targets ◦ Pollution control: instruments ◦ Pollution policy with imperfect information 3. PROJECT APPRAISAL ◦ Cost benefit analysis 4. NATURAL RESOURCE EXPLOITATION ◦ Valuing the environment ◦ The efficient and optimal use of natural resources ◦ Non-renewable resources ◦ Renewable resources		
Literature:	Perman, R., Common, M., McGilvray, J., Ma, Y. (2003). Natural resource and environmental economics Course presentations are available on Minerva.		
Types of Teaching:	S1 (WS): 25.0 h / Lectures / Lectures (1,67 SWS) S1 (WS): accompanied self-study 5.0 h, group work 5.0 h, plenary exercises 5.0h, seminar 5.0 h / Seminar (1,33 SWS)		
Pre-requisites:	**Recommendations:** General economics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA: Final score= 3/6 theory + 1/6 exercises + 2/6 group work [120 to 240 min] AP: Exercises AP: Group Work Class attendance is required.		

	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA: Final score= 3/6 theory + 1/6 exercises + 2/6 group work [120 bis 240 min] AP: Übungen AP: Gruppenarbeit Anwesenheit ist erforderlich.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA: Final score= 3/6 theory + 1/6 exercises + 2/6 group work [w: 3] AP: Exercises [w: 1] AP: Group Work [w: 2]
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Data:	LCAMS. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Life Cycle Assessment of Materials and Structures**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Verbeken, Kim / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	CONCEPTS: Technical durability, chloride- and carbonation-induced steel corrosion, corrosion initiation, corrosion propagation, Fick's first and second law of diffusion, probabilistic service life prediction, first order reliability method, Monte Carlo analysis, remaining service life, sustainability, life cycle assessment, functional unit, system boundaries, cradle-to-gate/cradle-to-grave/cradle-to-cradle, life cycle inventories (LCIs), environmental product declarations (EPDs), life cycle impact assessment (LCIA), problem and damage oriented impact methods, environmental impact, climate change, abiotic depletion, acidification, eutrophication, human toxicity, ecotoxicity, ozone layer depletion, chain management, eco-labels, recycling, reuse, ... INSIGHTS: insight in how basic material properties like mechanical strength and service life of a material can have a major effect on its environmental impact when considering the full life cycle of the material; insight in how the outcome of service life prediction can vary significantly with the assumed model input; insight in the importance of choosing a proper unit for environmental impact quantification which accounts for all the relevant functionalities of the material; insight in the advantages and disadvantages of different allocation principles (mass versus economic allocation) and impact methods (problem versus damage oriented impact assessment) ABILITIES/ATTITUDES: Being aware of the different material properties to consider when using a building material in an environment with specific exposure conditions. Being able to make a proper material choice for a specific building application. Being able to perform an adequate service life prediction for steel reinforced concrete and evaluate the uncertainty on this service life estimation based on a thorough sensitivity analysis in the software Comrel. Being able to consequently quantify the environmental impact of potentially 'green' construction materials using common LCA principles in the software SimaPro.		
Contents:	• Brief recapitulation of the durability issues relevant for steel reinforced concrete • Overview of the main properties and durability issues of natural stone, metals and wood • Physical background on the different probabilistic models for service life estimation of concrete exposed to chloride- and carbonation-induced steel corrosion • Prescription versus performance based structural design • Introduction to different model codes for service life design (DuraCrete, fib Bulletin 34) • Sensitivity study of the relevant model input parameters (e.g. concrete cover, critical chloride content, age factor, time of wetness, ...) to the service life prediction models • Characterization of the different model input parameters in terms of their most suitable probabilistic distribution • Project work/case studies assessing the remaining service life of existing concrete structures in the software Comrel		

	• Sustainable development: environmental problems (greenhouse effect, use of non-renewable materials/energy/land, ozone layer depletion, acidification, eutrophication, human toxicity, ecotoxicity, …), sustainability, factor 20, … • Life cycle thinking in accordance with the ISO 14040-14044 standards (the traditional four-step approach with (i) definition of goal and scope, (ii) inventory analysis, (iii) impact analysis and (iv) interpretation, cradle-to-gate/cradle-to-grave/cradle-to-cradle studies, functional unit choice accounting for the strength and service life of the material, mass versus economic allocation of impacts when dealing with industrial by-products, problem versus damage oriented impact assessment, aggregation and weighing of impacts • Resource conservation, pollution prevention, use of building and demolition waste, waste disposal, recycling and reuse, design for recycling, IFD • Quantifying the effective sustainability of potentially 'green' building materials using the principles of life cycle assessment • Eco-labels, environmental product declarations (EPDs), environmental audits, LCA databases (e.g. Ecoinvent) • Project work/case studies involving the use of the LCA software SimaPro
Literature:	Hendriks, Ch.F. Sustainable Construction. Best, Aeneas, ISBN 90 75 365 43-8. Alexander, M., Bertron, A., De Belie, N. (Eds.) (2012). Performance of cement-based materials in aggressive aqueous environments. State-of-the-Art Report, RILEM TC 211 – PAE. Springer, 449 p., ISBN 978-94-007-5412-6. DuraCrete (2000). Probabilistic performance based durability design of concrete structures: General guidelines for durability design and redesign. Document BE95-1347/R15. Gouda: CUR. fib Bulletin 34 (2006). Model code for service life design. Lausanne: fib.
Types of Teaching:	S1 (SS): 17.0 h / Lectures (1,13 SWS) S1 (SS): Project work 10.0 h, Excursion 3.0 h / Seminar (0,87 SWS)
Pre-requisites:	**Recommendations:** Knowledge of physics, chemistry, material sciences and concrete technology (level bachelor in civil engineering or engineering: architecture)
Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0)

	bewertet sein.
Credit Points:	3
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 3] AP*: permanent evaluation/assignments [w: 2] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	LSBP. MA. Nr. / Examination number: -	Version: 08.01.2016	Start Year: WiSe 2017
Module Name:	**Literature Study and Business Plan**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Haseneder, Roland / Dr. rer. nat. Schlömann, Michael / Prof. Dr. Bertau, Martin / Prof. Dr. Joseph, Yvonne / Prof. Dr. rer. nat. Stelter, Michael / Prof. Dr.-Ing. Frisch, Gero / Prof. Dr.		
Institute(s):	Institute of Thermal, Environmental and Natural Products Process Engineering Institute of Biosciences Institute of Chemical Technology Institute of Electronic and Sensor Materials Institute for Nonferrous Metallurgy and Purest Materials Institute of Inorganic Chemistry		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to: • Consult specialist literature and interpret it critically according to scientific standards. • Plan, monitor and steer scientific research. • Collect , process, critically analyse and interpret data. Identify new and remaining bottlenecks and research questions based on knowledge, insights and experience. • Deploy own knowledge in a creative, purposeful and innovative way in research, design and production processes. • Argue in a scientifically correct way in a multidisciplinary context. • Exhale openness to innovative scientific developments and their applications in a broad scientific, economic and social context. • Adopt an active attitude towards permanent knowledge development, lifelong learning and steer the own learning process independently. • Clearly communicate research results in English. • Conceptualize, plan and execute independently result-oriented new concepts at the level of a starting professional. • Understand the complexity of a problem/system using quantitative methods. • Extract useful information from superfluous, incomplete or contradictory data. • Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process idea. • Integrate aspects related to sustainable resource management into research, production, quality assessment, management and/or policy. • Entrepreneurial mindset to develop new ideas within a multidisciplinary context. After passing the course, the student should be able to describe and understand the essence of:		

	• Problem solving – how to analyse a complex problem • Basic project design • Innovation and entrepreneurship essentials • Project planning and project management basics • An overview of scientific methods • Problem characteristics and the choice of methods • Group dynamics and group thinking • IQ and emotional intelligence • Basic presentation techniques and rhetoric
Contents:	The students will prepare a written thesis. It will be compilation of self -researched literature on a given specific scientific or technical question and should include possible business models to generate systems, products, services or processes. The results from the thesis will be presented in a seminar lecture and discussed afterwards. The students should attend most of the other presentations and participate actively in the corresponding discussions.
Literature:	Depend on selected topic
Types of Teaching:	S1 (WS): incl. consultations with the supervisor / Seminar (3 SWS)
Pre-requisites:	
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written thesis AP*: Active participation in the seminar AP*: presentation * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Seminararbeit AP*: Aktive Teilnahme am Seminar AP*: Präsentation * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written thesis [w: 3] AP*: Active participation in the seminar [w: 1] AP*: presentation [w: 2] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.

Data:	MTSIM. MA. Nr. / Examination number: -	Version: 12.01.2016	Start Year: SoSe 2017
Module Name:	**Master Thesis in Sustainable and Innovative Natural Resource Management**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Alle am Masterstudiengang beteiligten Hochschullehrer		
Institute(s):			
Duration:	1 Semester(s)		
Competencies:	The students should get the ability to solve scientific tasks in the field of advanced resource managment. They should be able to prepare a scientific presentation of its work and defend it in front of an audience. Economic aspects also have to be considered in the work. The thesis can be written in any institute at the university which provided a obligate lecture and/or in a company which was involved in the training. The master thesis is a kind of examination which completes the entire course. The work is the proof, that the students are able to solve scientific problems by their own.		
Contents:	Concept of the work schedule; analysis of literature; familiarize with methods, testing equipment, numerical methods; realization and analysis of tests in situ and in the laboratory; realization of calculations and numerical simulations; summary, scientific analysis and generalization of the results (period of four months). Preparation of a scientific work and paper in a colloquium (30 min oral presentation with discussion)		
Literature:	Guideline for the preparation of scientific works at TU Bergakademie Freiberg from 27.06.2005, DIN 1422, part 4 (08/1985); Hints for taskspecific literature will be given.		
Types of Teaching:	S1: Consultations, on demand: instruction in laboratory work and software, colloquium / Thesis (24 Wo) / Thesis		
Pre-requisites:	**Mandatory:** Abschluss aller Module, bis auf Wahlpflichtmodule im Umfang von maximal 8 Leistungspunkten.All modules have to be passed, expect elective modules totalling 8 credit points.		
Frequency:	constantly		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written thesis MP*: Oral defense on the topic of the written thesis [30 to 35 min] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Masterarbeit MP*: Verteidigung der Masterarbeit [30 bis 35 min] * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		

Credit Points:	30
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written thesis [w: 3] MP*: Oral defense on the topic of the written thesis [30 to 35 min] [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 900h. It is the result of 0h attendance and 900h self-studies.

Data:	MatProp. MA. Nr. 3213 / Examination number: -	Version: 03.02.2011	Start Year: WiSe 2011
Module Name:	**Material Properties**		
(English):			
Responsible:	Biermann, Horst / Prof. Dr.-Ing. habil		
Lecturer(s):	Meyer, Dirk / Prof. Dr. rer. nat. Weidner, Anja / Dr.-Ing.		
Institute(s):	Institute of Experimental Physics Institute of Materials Engineering		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with: (i) metallic materials (ferrous materials, non-ferrous metals, light metals, high-temperature metals), their microstructure and mechanical properties as well as heat treatment. Focus is given to plastic deformation and failure. The module will enable the students to differentiate the different groups of metallic construction materials. (ii) semiconductors (processes within semiconductor devices and the quantitative description of these processes as well as the basis of application and design principles of semiconductor devices)		
Contents:	Most important ingredients are: Metallic Materials: Ferrous metals (plain carbon steels, high-alloyed steels, cast irons); Non-ferrous metals (e.g. copper, nickel) Light metals (aluminum, titanium, magnesium) High-temperature alloys (superalloys, intermetallic alloys) Semiconductors: Density and transport of charge carriers in thermodynamic equilibrium, doping, effects of impurities like traps, recombination centers, life-time of carriers, diffusion length, p-n-junctions and applications, diodes, junction transistors, sensors, photovoltaic elements, metal-semiconductor contacts and applications; Schottky diodes, FET.		
Literature:	Metallic Materials: M. F. Ahby, D.R.H. Jones, Engineering materials 2, 2nd ed., Butterworth-Heinemann, Oxford, 1998 James F. Shackelford, Introduction to Materials Science for Engineers, 7th ed. Addison Wesley., 2009 Ceramics, Glass and Construction Materials: Introduction to Ceramics, Kingery Semiconductors: Standard references of solid state physics for physicists, standard references of semiconductors devices for physicists (e. g. Ch. Kittel: Introduction to Solid State Physics, S.M.Sze: Semiconductor Devices)		
Types of Teaching:	S1 (WS): Metallic Materials / Lectures (2 SWS) S1 (WS): Semiconductors / Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Basic fundamentals of physics, chemistry and solid materials		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA: Metallic Materials (KA if 5 students or more) [MP minimum 30 min / KA 120 min] MP/KA: Semiconductors (KA if students or more) [MP minimum 45 min / KA 120 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:		

	MP/KA: Metallische Werkstoffe (KA bei 5 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] MP/KA: Halbleiter (KA bei und mehr Teilnehmern) [MP mindestens 45 min / KA 120 min]
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA: Metallic Materials [w: 1] MP/KA: Semiconductors [w: 1]
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.

Data:	MScT. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Materials Science Thermodynamics**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	De Graeve, Iris / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	NOTIONS: Electrochemical processes; Thermodynamic functions; Phase equilibria; Kinetics INSIGHTS: Obtaining fundamental knowledge of thermodynamics for other courses in materials science; Reasoning about the interactions in pyrometallurgy SKILLS: Knowledge of the notions required in electrochemical processing of materials, metal extraction and recycling; Knowledge of the notions required in the development of alloys; Knowledge of the notions related to the sustainability of materials; Knowledge of the notions concerning thermodynamic stability of ceramic materials; Use and interpretation of thermodynamic databaes; Knowledge of the limitations of thermodynamic databases		
Contents:	**For the part on Electrochemistry:** Fundamental principles and concepts: Electrodes and electrochemical reactions, oxidation and reduction, Definition of equilibrium cell potential, standard electrode potential, Nernst equation, activity versus concentration, reference electrodes, galvanic cell, Pourbaix diagram, Flux equation: diffusion, migration and convection of ions in solution, Concepts and modelsof the double layer, Kinetics and mechanisms of electrode processes: rate sconstants, electron charge transfer and current density, Butler-Volmer equation, kinetic factors (charge transfer coefficient and exchange current density), polarization curve, overpotential, influence of mass transfer (concepts limiting current and mixed kinetics). Methods: Global methods: polarization curves or linear sweep voltammetry (LSV), cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), Local methods: micro-cell, scanning vibrating electrode technique (SVET), scanning elektrochemical microscopy (EIS), ... Applications and examples: Examples of corrosion, Production of aluminium, Batteries and fuel cells. **For the part on Thermodynamics:** General definitions used in thermodynamics, the first, second and third law of thermodynamics Thermodynamic functions: Equilibrium constant and thermodynamic functions, Heat content and enthalpy of formation, Temperature dependence of the reaction enthalpy, Entropy, Gibbs free enthalpy and reaction equilibrium Phase equilibrium: Two phase equilibrium, Law of Clausius Clapeyron, Multicomponent systems, Gibbs phase rule, Ellingham diagrams (with nomographic scales and limitations) Metallic solutions: Partial molar quantities and integral molar quantities, The chemical potential, Ideal solutions and Raoult's law, Standard states and activities, Non-ideal solutions and activity coefficients, Non ideal solutions and Henry's law, relation between ideal Raoult behavior and ideal Henry behavior, Transformation between different standard states,		

	Integration of Gibbs Duhem's equation for binary solutions, Thermodynamic functions of mixing, Exces quantities, "Regular solutions", Sieverts' law Thermodynamic treatment of metallurgical processes: Siderurgy, Non-ferrous metallurgy Thermodynamics and Kinetics of electrometallurgical processes: Equilibrium potentials, Pourbaix diagrams, Cell potentials, Electrode kinetics (Butler Volmer), Electrode polarisation, Cou
Literature:	GASKELL D.R., 'Introduction to the thermodynamics of materials', Taylor&Francis, 2003 BRETT C.M.A., BRETT A.M.O., ‘Electrochemistry: Principles, Methods and Applications’, Oxford Science Publications, 1993
Types of Teaching:	S1 (WS): 20.0 h, practicum 5.0 h, practical PC room classes 20.0 h, guided self-study 15.0 h / Seminar (4 SWS)
Pre-requisites:	**Recommendations:** basic knowledge chemistry (bachelor)
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 1] AP*: Permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.

Data:	MPET. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Membrane Processes in Environmental Technology**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Van Der Meeren, Paul		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Be able to select and apply membrane-based separation techniques in environmental technology.		
Contents:	1. Membrane separation processes ◦ Membranes & membrane processes ◦ Flux decline 2. Membrane filtration in environmental biotechnology ◦ Different membrane bioreactor processes ◦ Aerobic & anaerobic wastewater treatment ◦ Advantages and limitations of the MBR ◦ Energy consumption and economic assessment 3. Membrane processes in environmental technology ◦ Production of drinking water ◦ Recycling of waste water ◦ Additional polishing 4. Membrane bioreactors for waste gas treatment ◦ Gas-liquid contactors ◦ Applications in biological waste gas treatment ◦ Comparison with conventional bioreactors ◦ Membrane resistance ◦ Microbial growth in membrane bioreactors		
Literature:	not available		
Types of Teaching:	S1 (WS): 10.0 h / Lectures (0,67 SWS) S1 (WS): demonstration 2.5 h, practicum 12.5 h, coached exercises 5.0 h / Seminar (1,33 SWS)		
Pre-requisites:	**Recommendations:** General knowledge of chemistry, physics and mathematics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w):		

	KA* [w: 1] AP*: Permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	MER. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Metal Extraction and Recycling**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Vervynckt, Stephanie / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Have insight in the production process of iron and steel (siderurgy), and basic non-ferrous metals (copper, lead, zinc), environmental issues related to the production of metals, recycling aspects included, obtain know-how in the field of flow sheet design of metal production processes.		
Contents:	Introduction: Metal extraction in Belgium Siderurgy: Production of pig iron, Production of steel, Electrosteel process for the treatment of scrap and/or reduced pellets Non-ferrous metallurgy: Unit processes in pyrometallurgy, Unit processes in hydrometallurgy, Copper metallurgy, Zink metallurgy, Lead metallurgy Environmental issues in metal production: Reduction of energy consumption and emissions, Secondary resources and recycling Flowsheet design: General rules		
Literature:	F. Habashi, 'Handbook of extractive metallurgy', Wiley, 1997 (ISBN 3 527 28792 2)		
Types of Teaching:	S1 (SS): 15.0 h / Lectures (1 SWS) S1 (SS): seminar 5.0 h, excursion 5.0 h, plenary exercises 5.0 h / Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** having followed the "Materials Science Thermodynamics" course		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: Permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 1] AP*: Permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		

Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	MRTec. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Microbial Re-use Technology**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Rabaey, Korneel / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Critically evaluating and presenting diverse microbiologically based technologies for reuse.		
Contents:	**Theory** 1. Water reuse 2. Composting 3. Risk assessment in water reuse 4. Sustainable use of water, nutrients and energy in aquaculture 5. Anaerobic digestion 6. Solids digestion 7. The carboxylate platform: bioproduction from waste 8. Biological gas treatment 9. Sulfur management and recovery 10. Nitrogen and phosphorus recovery 11. Minerals recovery and upgrading 12. Bioelectrochemical systems 13. Bioremediation 14. Source separation opportunities for domestic wastewater **Practical ecxercises** 1. Term paper relating to own lecture 2. Computer exercises: Simulation of an anaerobic digester 3. Company visits		
Literature:	Rabaey, K. and W. Verstraete (2005). "Microbial fuel cells: novel biotechnology for energy generation." Trends in Biotechnology 23(6): 291-298 Resource recovery and reuse in organic solid waste treatment. Eds. Piet Lens, Bert Hamelers, Hany Hoitink & Werner Bidlingmaier. IWA publishing 2005. ISBN 184339 054X Biofuels for fuel cells: Renewable energy from biomass fermentation. Eds. Piet Lens, Peter Westermann, Marianne Haberbauer and Angelo Moreno. IWA publishing 2005. ISBN 184339 092 2		
Types of Teaching:	S1 (SS): 7.5 h / Lectures (0,5 SWS) S1 (SS): excursion 5.0 h, practical PC room classes 10.0 h, guided self-study 2.5 h, microteaching 35.0 h / Seminar (3,5 SWS)		
Pre-requisites:	**Recommendations:** The student needs to have followed the course “Biotechnological processes of Environmental Sanitation” or “Environmental technology: water” or an equivalent course concerning biological wastewater treatment"		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: permanent evaluation/assignments Class attendance is required.		

	* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 1] AP*: permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	MICENER. MA. Nr. 3049 / Examination number: -	Version: 05.10.2009	Start Year: WiSe 2009
Module Name:	**Microbiology of Fossil and Regenerative Energy Resources**		
(English):			
Responsible:	Schlömann, Michael / Prof. Dr.		
Lecturer(s):	Schlömann, Michael / Prof. Dr. Mühling, Martin / Dr. Kaschabek, Stefan / Dr.		
Institute(s):	Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The students will obtain insight into mechanisms of aerobic and anaerobic degradation of organic compounds. They will understand how and why ethanol or methane are produced by microorganisms as well as the limits of such processes. They will also understand microbiological processes in the subsurface affecting oil and gas deposits as well as underground CO_2 storage. In the lab course students will gain experience in working with anaerobic and with phototrophic microorganisms. In a seminar the students will become acquainted with current literature and with reporting about it to other participants.		
Contents:	• Fermentations, bioethanol processes, anaerobic food chain, synthrophy, biogas formation. • Aerobic and anaerobic degradation of alkanes and aromatic compounds. • Biosurfactants. • Reasons for poor degradation of naturally occurring organic compounds. • Microbial communities in gas and oil reservoirs. • Oil deterioration. • Deep biosphere. • Biochemical CO_2 trapping. • Phototrophic microorganisms, biochemical hydrogen formations.		
Literature:	W. Reineke & M. Schlömann: Umweltmikrobiologie, Spektrum Akademischer Verlag; B. Ollivier & M. Magot (Hrsg.): Petroleum Microbiology, ASM Press; S. Lang & W. Trowitzsch-Kienast: Biotenside, Teubner		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): Lab course / Practical Application (1 SWS) S1 (WS): Excursion (0,5 SWS)		
Pre-requisites:	**Recommendations:** Bachelor-degree in chemistry, applied science, geoecology, biology, process engineering or in another area of science or engineering. Knowledge and experiences from a Microbiological and/or biochemical lab course.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [20 to 30 min] PVL: Accepted protocols for lab course. PVL: Acceptable oral presentation in the seminar. PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [20 bis 30 min] PVL: Testierte Protokolle im Laborpraktikum		

	PVL: Erfolgreiche mündliche Präsentation im Seminar PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]
Workload:	The workload is 120h. It is the result of 52.5h attendance and 67.5h self-studies. The latter comprises preparation and repetition of lecture material, the preparation of a presentation in the seminar, the preparation for the lab course, the writing of protocols on the experiments, and the preparation for the oral exam.

Data:	MOLECOL. MA. Nr. 3042 / Examination number: -	Version: 25.09.2009	Start Year: WiSe 2009
Module Name:	**Molecular Ecology of Microorganisms**		
(English):			
Responsible:	Schlömann, Michael / Prof. Dr.		
Lecturer(s):	Schlömann, Michael / Prof. Dr. Mühling, Martin / Dr.		
Institute(s):	Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The students will obtain insight into various molecular techniques to analyse microbial communities. They will understand the advantages and limitations of specific techniques. In the lab course they will obtain experience with some of the techniques. In a seminar the students will gain experience with current literature and with reporting about it to other participants.		
Contents:	Molecular methods for the identification of isolated bacteria. Fluorescence in situ hybridisation (FISH), catalyzed reporter deposition FISH (CARD-FISH), membrane hybridization, sequencing of clone banks with PCR products, amplified ribosomal DNA restriction analysis (ARDRA), restriction fragment length polymorphisms (TRFLP), temperature and denaturing gradient gel electrophoresis (TGGE, DGGE), single strand conformation polymorphism (SSCP), real-time PCR.		
Literature:	W. Reineke & M. Schlömann: Umweltmikrobiologie, Spektrum Akademischer Verlag; A. M. Osborn & C. J. Smith: Molecular Microbial Ecology, Taylor and Francis; Kowalchuk, de Bruijn, Head, Akkermans, van Elsas: Molecular Microbial Ecology Manual, Springer		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): Practical Application (1 SWS)		
Pre-requisites:	**Recommendations:** Bachelor-degree in chemistry, applied science, geoecology, biology, process engineering or in another area of science or engineering. Knowledge and experiences from a Microbiological biochemical lab course.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] PVL: Accepted protocols for lab course PVL: Acceptable oral seminar presentation PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Testierte Versuchsprotokolle aus Praktikum PVL: Erfolgreiche Präsentation im Seminar PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies. The latter comprises preparation and repetition of lecture		

	material, the preparation of a presentation in the seminar, the preparation for the lab course, the writing of protocols on the experiments, and the preparation for the oral exam.

Data:	PCPRM. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2017
Module Name:	**Physical and Chemical Properties of Rocks, Minerals and Materials**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Malehmir, Alireza		
Institute(s):	University Uppsala		
Duration:	1 Semester(s)		
Competencies:	After completion of the course the student should be able to: describe relationships between different properties, compare different types of minerals, rocks and their physical and chemical properties, formulate different systems of symmetries and anisotropic systems associated with each system, relate scale dependencies between various measurements (lab, field and/or downhole), design suitable geophysical and laboratory methods for the exploration and/or processing of a given mineral.		
Contents:	This course is divided into physical and chemical properties. Physical properties: (1) an introduction on rocks and minerals, (2) density, porosity, permeability, (3,4) elastic and inelastic properties, (5) rock quality and seismic properties, (6) magnetic (7) electric and (8) thermal properties of rocks, (9) in-situ and downhole physical property measurements. Chemical properties will include mineral and material structures, composition and alloying, thermodynamics of minerals and materials, investigation of chemical properties by analytical methods.		
Literature:			
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Seminar (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.		

Data:	SINREMB. MA. Nr. / Examination number: -	Version: 08.01.2016	Start Year: WiSe 2016
Module Name:	**Problems and Innovations in the Process Chain of Rare Resources**		
(English):			
Responsible:	Haseneder, Roland / Dr. rer. nat.		
Lecturer(s):	Haseneder, Roland / Dr. rer. nat. Schlömann, Michael / Prof. Dr. Joseph, Yvonne / Prof. Dr. rer. nat. Stelter, Michael / Prof. Dr.-Ing. Frisch, Gero / Prof. Dr.		
Institute(s):	Institute of Thermal, Environmental and Natural Products Process Engineering Institute of Biosciences Institute of Electronic and Sensor Materials Institute for Nonferrous Metallurgy and Purest Materials Institute of Inorganic Chemistry		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to explain real world problems in the process chain of special resources. They have an understanding about how different sectors have to interact to form a working unit in research.Innovative solutions on current issues in industries shall be highlighted and still occurring problems discussed to create an idea of entrepreneurship for various fields of the here outlined process chain.		
Contents:	1. Introduction of lecturers, companies, and students by short talks. Later social events will force the team building. 2. 5 Lectures on the process chain (Preprocessing technologies, (Bio-)Leaching, Separation processes, Hydrometallurgy, Process analysis) in combination with seminars to form working groups on individual topics. 3. Excursions and field trips, company talks and lectures.		
Literature:	not applicable		
Types of Teaching:	S1 (WS): Lectures - Bloc course / Lectures (1 SWS) S1 (WS): with short report of the team - Bloc course / Seminar (2 SWS) S1 (WS): Excursion - Bloc course / Excursion S1 (WS): Thesis - Bloc course / project (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Short written report of the team		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Schriftliche Gruppenarbeit		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Short written report of the team [w: 1]		
Workload:	The workload is 120h. It is the result of 60h attendance and 60h self-studies.		

Data:	PMTST. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2015
Module Name:	**Process Modeling in Thermal Separation Technologies**		
(English):			
Responsible:	Repke, Jens-Uwe / Prof. Dr.		
Lecturer(s):	Repke, Jens-Uwe / Prof. Dr.		
Institute(s):	Institute of Thermal, Environmental and Natural Products Process Engineering		
Duration:	1 Semester(s)		
Competencies:	The students will obtain knowledge about dynamical and stationary modeling. Focus is also put on process synthesis. They will obtain the mathematical basic for process modeling and an overview about flow-sheet-simulators and solver tools. In a practical course they will obtain experience with the regarded software solutions and the application on thermal separation technologies.		
Contents:	• basics on modeling • dynamic models, principles of process analysis • fundamentals of process development • process optimization and the process integration • practical model formulation, numerical solution of stationary and dynamic models		
Literature:	Smith, R.: Chemical Process Design and Integration, Wiley-VCH, 2005 Douglas, J. M.: Conceptual Design of Chemical Processes, McGraw-Hill, 1988 Luyben, W. L.: Process Modelling, Simulation and Control for Chemical Engineers. McGraw-Hill, 1989		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): Practical Application (2 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [60 min] PVL: Exercises PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [60 min] PVL: Belege PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]		
Workload:	The workload is 150h. It is the result of 75h attendance and 75h self-studies.		

Data:	RUOM. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Rational Use of Materials**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Verbeken, Kim / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	• Having the attitude to design enviromental friendly products taking into account the sustainable use of materials and energy. • Making the link between design and recycling. • Having the possibility to integrate society oriented sciences into the design or research of products or processes. • Having a good insight in the environmental issues. • Understanding the recyclability of materials. • Having the possibility to enter into a broad social discussion concerning the enviromental issues.		
Contents:	• Introduction to the different material properties and material groups and the correlation between material properties and material selection. • Life cycle analysis of materials and products. • Definition of the production process. • Use of materials, Use of energy. • Emissions of gasses or generation of residual products. • Recycling of used products. • Problems in recycling. • Recycling of used products or base materials. • Issues in incineration. • Materials: recycling and re-use. • Seperation and recycling of several materials. • Choice of the recycling process. • Completed with Case Studies on the recycling of e-scrap and precious metals, on the impact of design and material selection on the recycling of light weight vehicles, on advanced recycling technologies.		
Literature:	not available.		
Types of Teaching:	S1 (WS): 30.0 h / Lectures (2 SWS) S1 (WS): 15.0 h / Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Basics on chemistry and physics as lectured in the bachelor		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP: Including written preparation [30 to 60 min] Class attendance is required.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP: Inkl.schriftlicher Vorbereitung [30 bis 60 min] Anwesenheit ist erforderlich.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP: Including written preparation [w: 1]		
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.		

Data:	RMNS. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2017
Module Name:	**Raw Materials Network Seminar**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Persson-Fischier, Ulricka		
Institute(s):	University Uppsala		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to: • Reflect upon and critically evaluate evidence from different sources. • Integrate and evaluate competing evidence from different perspectives on the same case. • Compare the advantages and disadvantages of different solutions. • Appraise complex issues on local, regional and global scales to construct a holistic understanding of the problem.		
Contents:	Five to six KIC partners both Universities such as UU and TU Freiberg as well as industry partners, such as Sandvik, Umicore, Boliden, and at least two other KIC masters programmes will form a network offering case problems with recommended reading. The case will be supported by introductory lectures provided as e-learning components. Each case will be concluded by a video seminar. The case will describe a problem and challenge students to reflect upon technical, scientific, innovative, political, economic, societal, environmental and sustainable issues influencing the solution to the problem. Examples of possible cases include, mining in Northern Sweden and the local Sami population. Other examples of case topics are exploration, microbiology, potential for green mining, experimental evaluation.		
Literature:			
Types of Teaching:	S1 (SS): Seminar (6 SWS)		
Pre-requisites:			
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Report based on a related topic,lead a seminar, active participation in the online discussion forum		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Belegarbeit zum verwandten Thema, Seminarführung, aktive Teilnahme am Online-Diskussionsforum		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Report based on a related topic,lead a seminar, active participation in the online discussion forum [w: 1]		
Workload:	The workload is 150h. It is the result of 90h attendance and 60h self-studies.		

Data:	RESA. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Resource Assessment**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Barker, Abigail		
Institute(s):	University Uppsala		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to: • Assess a mineralisation for resource potential. • Appraise the environmental sensitivity of an area and design a plan for monitoring and remediation. • Evaluate the resource from the perspectives of economics, politics and society.		
Contents:	This course will focus on the integration of evidence from the perspectives of natural resource, the environment and society to assess resource feasibility. The course will include reconnaissance, target appraisal, exploration and assessment of feasibility. It will feature the mutual assessment of environmental baselines, local stakeholder relations, politics and economics, permits and legislation and plans for remediation. Industrial partners such as Boliden as well as local government and environmental agencies involvement will be sought.		
Literature:			
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Seminar presentation AP*: Written report for a case based project * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Präsentation AP*: Schriftlicher Beleg zur fallbasierten Projektarbeit * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Seminar presentation [w: 1] AP*: Written report for a case based project [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.		

Data:	RRTec. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Resource Recovery Technologies**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Du Laing, Gijs / Prof. Rabaey, Korneel / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	The promovendus of the course is capable to comprehend the engineering principles of the (unit) processes covered in the course, and evaluate a technical description of a waste treatment system/installation. The promovendus should be able to specify the requirements which a waste treatment installation needs to fulfil and have insights in the potential use of the different processes when designing technologies for recovery of resources from waste.		
Contents:	Part A: Treatment of liquid waste 1. Mechanical treatment processes 2. Chemical and physical-chemical treatment processes (coagulation and flocculation, membrane techniques, electrochemistry) 3. Biological treatment processes Part B: Solid waste treatment 1. Introduction (waste and material cycles, waste and waste management in Europe, integrated waste management) 2. Physical transformations 3. Thermal transformations 4. Biological transformations 5. Landfilling		
Literature:			
Types of Teaching:	S1 (WS): Part A: Treatment of liquid waste / Lectures (2 SWS) S1 (WS): Part B: Solid waste treatment / Lectures (2 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 180 min] MP* [15 to 30 min] AP*: Assignments/exercises during the semester * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 180 min] MP* [15 bis 30 min] AP*: Belege/Übungen * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		

Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 10] MP* [w: 6] AP*: Assignments/exercises during the semester [w: 4] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	RCTec. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Resources Chemical Technology**		
(English):			
Responsible:	Bertau, Martin / Prof. Dr.		
Lecturer(s):	Bertau, Martin / Prof. Dr.		
Institute(s):	Institute of Chemical Technology		
Duration:	1 Semester(s)		
Competencies:	After completing this module, students should be able to ◦ understand raw material processing on a technical scale ◦ explain the chemical-technological concepts behind modern production techniques		
Contents:	**Fundamentals:** Chemical technology of raw material recovery processes, chemistry of main group and transition metals as well as lanthanides, basic unit operations, basic reaction engineering. **Applications:** Realisation of raw material processing on a technical scale, process economy, environmental safeguards.		
Literature:	M. Bertau, P. Fröhlich, M. Katzberg, Industrial Inorganic Chemistry, Wiley, 2016 Kirk-Othmer et al., Chemical Technology, Wiley, 2013 J. Huheey et al., Inorganic Chemistry, Pearson, 2008		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Tutorials / Exercises (1 SWS) S1 (WS): Case studies (problem-based learning workshops) / project (1 SWS)		
Pre-requisites:	**Recommendations:** Fundamental knowledge in chemical technology, chemical engineering and inorganic chemistry		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [60 to 120 min] AP*: Case study AP*: Report * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [60 bis 120 min] AP*: Projektarbeit AP*: Belegarbeit * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 2] AP*: Case study [w: 1] AP*: Report [w: 1] * In modules requiring more than one exam, this exam has to be passed		

	or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Data:	RECH. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Resources Chemistry**		
(English):			
Responsible:	Bertau, Martin / Prof. Dr. Frisch, Gero / Prof. Dr.		
Lecturer(s):	Bertau, Martin / Prof. Dr. Frisch, Gero / Prof. Dr.		
Institute(s):	Institute of Chemical Technology Institute of Inorganic Chemistry		
Duration:	2 Semester(s)		
Competencies:	After completing this module, students should be able to ◦ describe the chemical properties of complex raw materials, ◦ explain the chemical concepts behind modern enrichment, purification and production techniques, ◦ suggest a suitable technology for the processing of a particular resource.		
Contents:	**Fundamentals:** Chemistry of ore deposits, phase diagrams, basic coordination chemistry, modelling of solvation equilibria, kinetic aspects of precipitation and extraction, chemical foundations of metallurgical processes, and applied electrochemistry. **Applications:** Hydro- und pyrometallurgical processing and recycling technologies, such as smelting, leaching, digestion, flotation, extraction, precipitation, electrowinning and ion exchange; applications of unconventional solvents; economic viability of processing and separation techniques.		
Literature:	• J. Huheey et al., Inorganic Chemistry, Pearson, 2008 • M.Bertau et al., Industrial Inorganic Chemistry, Wiley, 2016 • Kirk-Othmer et al., Chemical Technology, Wiley, 2013		
Types of Teaching:	S1 (WS): Case Studies - E-Learning / Seminar (2 SWS) S2 (SS): Block-course / Lectures (2 SWS) S2 (SS): Block-course / Exercises (2 SWS) S2 (SS): Block-course with excursions / Practical Application (3 SWS) The order of the module semesters is flexible.		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [60 to 120 min] AP*: Continuous assessment of the problem-based learning workshops AP*: Practicals * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [60 bis 120 min] AP*: Belege zum Workshop problem-basiertes Lernen AP*: Übungen * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		

Credit Points:	9
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 2] AP*: Continuous assessment of the problem-based learning workshops [w: 1] AP*: Practicals [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 270h. It is the result of 135h attendance and 135h self-studies.

Data:	SSSE. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2015
Module Name:	**Selective Separation of Strategic Elements**		
(English):			
Responsible:	Haseneder, Roland / Dr. rer. nat.		
Lecturer(s):	Haseneder, Roland / Dr. rer. nat. Repke, Jens-Uwe / Prof. Dr.		
Institute(s):	Institute of Thermal, Environmental and Natural Products Process Engineering		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to explain membrane technology and the different applications like extraction and membrane assisted processes regarding the separation of value products. Focus is put on strategic elements. They can use their physico-chemical knowledge on membrane separation, development of hybrid operation systems and the influences for practical applications and are familiar with the methods and problems related to separation devices. Due to the seminar the students will be able to dicuss the current literature on the topic.		
Contents:	• membranes, modules, hybrid processes • driving forces, transport resistances • structures, materials • mass transfer • module construction • MF, UF, NF, RO • standard applications • scaling, fouling effects • special applications: mine water treatment, leaching solutions, resourcerecovery • internship to membrane processes		
Literature:	Heinrich Strathmann: Introduction to Membrane Science and Technology, Wiley-VCH, 2011 Anil K. Pabby, Syed S.H. Rizvi, Ana Maria Sastre Requena: Handbook of Membrane Separations, CRC-Press 2008		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): Practical Application (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [60 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [60 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]		
Workload:	The workload is 120h. It is the result of 60h attendance and 60h self-studies.		

Data:	SA. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Sensors and Actuators**		
(English):			
Responsible:	Joseph, Yvonne / Prof. Dr. rer. nat.		
Lecturer(s):	Joseph, Yvonne / Prof. Dr. rer. nat.		
Institute(s):	Institute of Electronic and Sensor Materials		
Duration:	1 Semester(s)		
Competencies:	Apply techniques for qualitative and quantitative exploration and physicochemical characterization of resources present in the environment, including spatial and temporal variability. Apply techniques to assess environmental impacts of products and processes. Insights in the different (technological) options for optimizing resource flows in the different parts of the value chain and be able to compare them, taking technical and economic aspects as well as social and environmental impact into account. Consult specialist literature and interpret it critically according to scientific standards. Understand the complexity of a problem/system using quantitative methods. Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process. Entrepreneurial mindset to develop new ideas within a multidisciplinary context.		
Contents:	Physical (e.g. temperature, force, acceleration, etc.) chemical (gas sensors, ion sensors) and biological sensors and actuators will be discussed. First, the physical principles are presented and then applications will be given. The focus is on the relationship between the parameters of the finished device and the properties of the used materials to enable their applications. Specific examples of sensors and actuators are discussed in their measurement environment.		
Literature:	Peter Gründler, Chemical Sensors, Springer, 2007, ISBN: 9783540457435;		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	SCPP. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Sustainable Chemical Production Processes**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Van Geem, Kevin / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	CONCEPTS: crude oil, distillate, residue, bulk chemicals, sustainability, life cycle analysis, biomass, process simulation INSIGHTS: structure of chemical industry, structure of a refinery; production methods of important chemicals; production of selected second generation chemicals; implementation of large-scale processes, biotechnical production processes SKILLS: evaluation of process efficiency and sustainability, identification of the most important streams in a refinery and treatment processes, Process simulation		
Contents:	• Structure of the chemical industry • Resources, process efficiency, waste, life cycle analysis, exergy Conversion of oil, biomass and coal. Production of fossil and renewable fuels. Overview of the final products • Sustainable production of Base Chemicals: hydrogen; carbon monoxide, ethene;propene; butenes; butadiene, Benzene; toluene; sustainablexylenes , acetic acid, sulfuric acid, ammonia, methanol, etc. • Sustainable production of second generation chemicals: Styrene, Hetero-atom: vinylchloride, Ethylene Oxide, Adipic Acid, Caprolactam, Maleic Anhydride • Important sustainable Processes: capita selecta: Steamreforming of natural gas; partial oxidation to synthesis gas or ethyne, Steam Cracking, Catalytic cracking; Catalytic reforming, High-Pressure Polyethylene, bioethanol • Plant visits: unit operations, sustainability, economics, continuous versus batch processes		
Literature:	Chemical Process Technology, Jacob A. Moulijn, Michiel Makkee, Annelies van Diepen, ISBN: 978-0-471-63062-3, 2001 ULLMANN'S Encyclopedia of Industrial Chemistry: http://www.wiley-vch.de/vch/software/ullmann		
Types of Teaching:	S1 (WS): 30.0 h / Lectures (2 SWS) S1 (WS): group work 15.0 h, excursion 15.0 h / Seminar (2 SWS)		
Pre-requisites:	**Recommendations:** Physical & Organic Chemistry, Heat and Material Transport, Unit Operations in the Chemical Industry		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA* [120 to 240 min] AP*: permanent evaluation/assignments Class attendance is required. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA* [120 bis 240 min] AP*: Belege		

	Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 3] AP*: permanent evaluation/assignments [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.

Data:	TCB. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: SoSe 2016
Module Name:	**Thermochemical Conversion of Biomass**		
(English):			
Responsible:	Wopat, Kristina / Dr.		
Lecturer(s):	Ronsse, Frederik / Prof.		
Institute(s):	University of Ghent		
Duration:	1 Semester(s)		
Competencies:	Traditional academic courses are organised to provide students in-depth training and intellectual focus in a single field such as agriculture, chemistry, engineering environmental science or economics. This course will give the students a broader perspective of the future bio-based economy. Students will acquire knowledge on thermo-chemical conversion of biomass, but in the setting of a multi-disciplinary approach.		
Contents:	Thermo-chemical biomass conversion is based on decomposition at high temperatures (and sometimes high pressures), and subsequent chemical conversion whether or not in the presence of catalytic materials. Traditional processes are combustion, gasification and carbonization. The corresponding products are heat, combustible gases and charcoal respectively. This course is meant to explain the principles of both traditional and new thermo-chemical conversion processes and to discuss the various process routes in relation to the products desired. Biomass resources and properties are considered with special attention for environmental impact and aspects of sustainability. Although biological conversion routes are not a topic in this course, the relation between biological and thermo-chemical process routes will be clarified. In modern bio-refinery concepts, both process types are often combined. Part 1: Biomass resources, types and properties Part 2: Traditional conversion processes and production routes Part 3: New thermo-chemical conversion processes Part 4: Fast pyrolysis Part 5: Bio-refinery concepts Part 6: Environmental impact and economics of biomass utilization		
Literature:	Robert C. Brown, “Bio-renewable Resources”, Iowa State Press, Ames, 2003 Robert C. Brown, "Thermochemical Processing of Biomass", John Wiley & Sons (9780470721117)		
Types of Teaching:	S1 (SS): 15.0 h / Lectures (1 SWS) S1 (SS): group work 20.0 h, self-reliant study activities 10.0 h / Seminar (2 SWS)		
Pre-requisites:	**Recommendations:** The course is meant for master students with a background in chemical, thermal or bioscience engineering. Basic knowledge of chemistry, transport phenomena, and process technology will make the course contents easier to understand. The course does not assume any previous training in bio-renewable resources.		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Permanent evaluation/assignments KA*: Written report KA*: Presentation Class attendence is required.		

	* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Belege KA*: Schriftliche Belegarbeit KA*: Präsentation Anwesenheit ist erforderlich. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Permanent evaluation/assignments [w: 1] KA*: Written report [w: 1] KA*: Presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Data:	TInI. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Training in Industry - I**		
(English):			
Responsible:	Tischler, Dirk / Dr.		
Lecturer(s):	Alle am Masterstudiengang beteiligten Hochschullehrer		
Institute(s):	Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The student is able to: • reflect critically on the experience gained. • integrate and participate in the day-to-day-activities of the workplace. • give a scientific account of the experience gained in the form of an oral presentation and a scientific report. • analyse the workplace and the activities it undertakes within it's economical, managerial or strategic context.		
Contents:	The student shall during 3 weeks (minimum) participate in a full-time internship, with an appointed supervisor within the host organization. The work/tasks during the internship must be clearly related to SINREM, and train the student in independent work and cooperation with others. Innovation and entrepreneurship in raw material and resource science are of major interest. The student will be engaged in every-day working activities at a level corresponding to the final degree. During the training the student has to report to a mentor which is a teacher of the courses of the program (should be elected in advance, one report is needed). Further a oral presentation will be given at the end of the training in front of the group of respective teacher. Upon completion of the internship, the student will write a report. In the report students will pay attention not only to the practical work they performed but also to methodology, results, managerial, economical and strategic aspects of the internship and workplace. Course introduction takes place at the university, while supervision is undertaken at the internship location.		
Literature:	not available		
Types of Teaching:	S1 (WS): Practical Application (4 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: PVL: Continuous written reports AP*: Final report AP*: Presentation PVL have to be satisfied before the examination. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: PVL: Kontinuierliche schriftliche Berichte AP*: Abschlussbericht AP*: Präsentation		

	PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Final report [w: 1] AP*: Presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	TInII. MA. Nr. / Examination number: -	Version: 12.01.2016	Start Year: WiSe 2017
Module Name:	**Training in Industry - II**		
(English):			
Responsible:	Tischler, Dirk / Dr.		
Lecturer(s):	Alle am Masterstudiengang beteiligten Hochschullehrer		
Institute(s):	Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The student is able to: • reflect critically on the experience gained. • integrate and participate in the day-to-day-activities of the workplace. • give a scientific account of the experience gained in the form of an oral presentation and a scientific report. • analyse the workplace and the activities it undertakes within it's economical, managerial or strategic context.		
Contents:	The student shall during 5 weeks (minimum) participate in a full-time internship, with an appointed supervisor within the host organization. The work/tasks during the internship must be clearly related to SINREM, and train the student in independent work and cooperation with others. Innovation and entrepreneurship in raw material and resource science are of major interest. The student will be engaged in every-day working activities at a level corresponding to the final degree. During the training the student has to report to a mentor which is a teacher of the courses of the program (should be elected in advance, two reports are needed). Further a oral presentation will be given at the end of the training in front of the group of respective teacher. Upon completion of the internship, the student will write a report. In the report students will pay attention not only to the practical work they performed but also to methodology, results, managerial, economical and strategic aspects of the internship and workplace. Course introduction takes place at the university, while supervision is undertaken at the internship location.		
Literature:	not available		
Types of Teaching:	S1: Practical Application (7 SWS) / Practical Application (7 SWS)		
Pre-requisites:	**Recommendations:** Completed first year of studies in the Master program for sustainable development		
Frequency:	constantly		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: PVL: Continuous written reports AP*: Final Report AP*: Presentation PVL have to be satisfied before the examination. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:		

	PVL: Kontinuierliche schriftliche Berichte AP*: Abschlussbericht AP*: Präsentation PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	10
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Final Report [w: 1] AP*: Presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 300h. It is the result of 105h attendance and 195h self-studies.

Data:	TInIII. MA. Nr. / Examination number: -	Version: 20.02.2015	Start Year: WiSe 2016
Module Name:	**Training in Industry - III**		
(English):			
Responsible:	Tischler, Dirk / Dr.		
Lecturer(s):	Alle am Masterstudiengang beteiligten Hochschullehrer		
Institute(s):	Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	The student is able to: • reflect critically on the experience gained. • integrate and participate in the day-to-day-activities of the workplace. • give a scientific account of the experience gained in the form of an oral presentation and a scientific report. • analyse the workplace and the activities it undertakes within it's economical, managerial and strategic context.		
Contents:	The student shall during 8 weeks (minimum) participate in a full-time internship, with an appointed supervisor within the host organization. The work/tasks during the internship must be clearly related to SINREM, and train the student in independent work and cooperation with others. Innovation and entrepreneurship in raw material and resource science are of major interest. The student will be engaged in every-day working activities at a level corresponding to the final degree. During the training the student has to report to a mentor which is a teacher of the courses of the program (should be elected in advance, two reports are needed). Further a oral presentation will be given at the end of the training in front of the group of respective teacher. Upon completion of the internship, the student will write a report. In the report students will pay attention not only to the practical work they performed but also to methodology, results, managerial, economical and strategic aspects of the internship and workplace. Course introduction takes place at the university, while supervision is undertaken at the internship location.		
Literature:	not available		
Types of Teaching:	S1 (WS): Practical Application (10 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: PVL: Continuous written reports AP*: Final report AP*: Presentation PVL have to be satisfied before the examination. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: PVL: Kontinuierliche schriftliche Berichte AP*: Abschlussbericht AP*: Präsentation		

	PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	15
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Final report [w: 1] AP*: Presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 450h. It is the result of 150h attendance and 300h self-studies.

Freiberg, den 20. Februar 2017

gez.
Prof. Dr. Klaus-Dieter
Barbknecht Rektor

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