Curriculum for the “Erasmus Mundus Master's Programme in Industrial Ecology“

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(Joint study according to § 51 par. 2 l 27 Austrian University Act, Dutch Act on Higher Education and Scientific Research, art. 7.13, and Swedish Law on Authorization to Grant Degrees SFS 2009, p.695)

§ 1 General

(1) Introductory Regulations

The curriculum for the "Erasmus Mundus Master's Programme in Industrial Ecology" was developed jointly by the following seven partner universities under the co-ordination of the University of Graz, Austria: University of Graz; Chalmers University of Technology (Sweden); Delft University of Technology (Netherlands); Leiden University (Netherlands); Asian Institute of Technology (Thailand); Rochester Institute of Technology (USA); and Waseda University (Japan).

Provided that no other legal regulations are binding for the cooperation partners, the University Act 2002 (in the following referred to as UA) and the applicable statutes of the University of Graz are to apply for this curriculum.

The above mentioned seven universities build a consortium, that stipulates its rights and duties in a co-operation agreement according to § 54 section 9 UA based on the "Consortium Agreement for the 'Erasmus Mundus Master's Programme in Industrial Ecology' (MIND)".

(2) Target Group

The target group for the "Erasmus Mundus Master's Programme in Industrial Ecology" are highly qualified and highly motivated students interested in interdisciplinary aspects of "Industrial Ecology" and especially in the international dimension of the implementation of sustainable concepts. Furthermore, they should be willing and able to analyze and assess complex processes from an interdisciplinary perspective.

(3) Conditions for Admission

Students who wish to apply for the joint master's programme have to go through an admission procedure, which is carried out by the Admission Committee (cf. Consortium Agreement, § 13). This Committee determines the most suitable candidates, based on a criteria system. This criteria system and the deadlines for the application are published each year on the following website: http://www.emmind.eu.

The entry requirements for the admission to the Master Programme "Erasmus Mundus Master's Programme in Industrial Ecology" is the completion of a subject-specific eligible Bachelor's degree or a subject-specific eligible Bachelor's degree at a University of Applied Sciences ("Fachhochschul-Bachelorstudiengang") or another equivalent study programme at a recognized Austrian or foreign post-secondary educational institution.

The evidence of the general university entrance ("Universitätsreife") is in any case provided through the evidence of entry requirements.

A subject-specific eligible Bachelor's programme in the fields of engineering sciences, natural sciences, environmental sciences, social sciences or economics of at least180 ECTS credits or equivalent must meet the following requirements:

- It contains courses with a total of at least 12 ECTS credits in mathematics and statistics and
- courses with a total of at least 12 ECTS credits in environmental science and systems science

Since the entire study will be held in English, evidence of the applicant's proficiency in English with the following thresholds is required:

- TOEFL (minimum required score: 230 on the computerized test, 575 on the paper test, 90 on the Internet test) or
- IELTS (minimum grade required: 6.5)
- or Cambridge Certificate of Proficiency in English (minimum grade required: C)

Candidates with English as mother tongue and those who successfully completed an English-taught bachelor programme do not have to take this test.

Selection results

The decision of the Selection Committee will be sent by letter to the applicant. The admission to the Master programme "Erasmus Mundus Master's Programme in Industrial Ecology" is granted by the Rector according to § 60 and § 64 section 6 UA by decree or by the responsible bodies of the partner universities, respectively. Following the regulations of the Consortium Agreement (cf.§ 13), maximal a total of 15 students from third countries and maximal a total of 10 students from EU countries plus Norway, Liechenstein and Iceland will be approved, thus maximal a total of 25 students. The Rectorate of University of Graz (according to § 64 section 6 UA) or the respective responsible bodies of the partner universities decide about the number of students that is proposed by the Programme Board (cf. § 13 of the Consortium Agreement).

(4) Subject of Study and Objectives

The European Union has, as a follow-up of the Lisbon strategy, adopted the Programme “Europe 2020”, a ten-year programme that aims at fostering an intelligent, sustainable and integrative growth of the European economy. Already today the EU has a significant share in the “green” technologies worldwide and promotes a further expansion of this position. The development of innovative technologies for the support of economic growth and the simultaneous reduction of resources and emissions is the underlying aim. Developing such technologies also implies putting them into a broader sustainability perspective. Simplistic solutions with negative side-effects or burden shifting to other areas, or to the future, should be avoided. A systems perspective is therefore required. Graduates of different studies benefit from the knowledge, which builds on their previous study, for the creation and optimization of technologies for sustainable development. The present study programme "Erasmus Mundus Master's Programme in Industrial Ecology" offers a comprehensive education in the field of integrated consideration and assessment of sustainable development and technical systems.

“Industrial Ecology“(IE) is an emerging interdisciplinary field combining natural, social, as well as technical sciences, which considers in an integrated systemic approach all different levels from global to the local.

Issues related to the environment require a systemic approach so that the connections and feedbacks between industrial activity, human activity and ecological processes can be incorporated in the assessment and problem solving. The issue of "industrial ecology" encompasses physical, chemical and biological links and interrelations between several industrial systems as well as between industrial and ecological systems.

The objective of the “Erasmus Mundus Master's Programme in Industrial Ecology” is to offer an international and interdisciplinary Master's programme at the highest level, which allows the participants to make an essential contribution to understanding and proposing solutions to problems in order to support the transition towards a sustainable society, cf. § 1(5) and § 1(6).

Through the composition of the consortium a unique view on the field of "Industrial Ecology" on a global, European and local level is possible. In this way, the students learn a methodologically correct approach to complex interdisciplinary issues and are introduced to specific subject areas by experts of the partner universities. Thereby, a strong emphasis is placed both on research and practical problem solving applications for sustainable development.

The “Erasmus Mundus Master's Programme in Industrial Ecology” takes a leading role as an interdisciplinary study programme at the highest level with an international direction. The perspectives are in particular based on the specialisations offered by partner universities. Based on the individual Bachelor education, the selected specialisations, the study stays abroad and the topic of the master thesis foster diverse perspectives in science as well as an appropriate foundation for the implementation in practice.

(5) Qualifications and Skills

Students should after completing this study programme be able

- To understand and to adequately describe the dynamics, complexity and interrelations between natural, technical, social and economic processes and systems in terms of sustainable development.
- To apply and improve state-of-the-art methods and techniques in the field of "Industrial Ecology". This particularly includes methods of system analysis, "Life Cycle Assessment," Material Flow Analysis, Input-Output Analysis, Stakeholder Analysis, "Transition Management", System Dynamics, “Agent Based Modelling" and the implementation, monitoring and management of innovation processes.
- To analyze problems in the field of Industrial Ecology such as waste, resource and technology management from a multidisciplinary perspective.
- To identify, analyze and assess environmental effects of processes, products, projects and strategies.
- To apply general academic skills for the Industrial Ecology context, such as the use of research methods and tools from statistics, data collection, modelling techniques, IT, as well as the critical application and evaluation of theories, concepts and principles.
- To clearly prepare the results in written form and for presentations for academic and non-academic target groups.
- To apply their knowledge and scientific skills on complex issues in inter- and transdisciplinary teams, furthermore to demonstrate necessary social skills (e.g. writing, discussion, conflict management, teamwork, project management) and therefore to be able to contribute to a transition towards a sustainable society.

(6) Demand and Relevance of the Programme for Science and the Job Market

Occupational areas, for which the competences are developed, are highly connected to the chosen specialization and include the academic, private, public and half-public sector. Typical occupational areas of the graduates are (in alphabetical order):

- Administration
- Environmental and management consultancy
- Industrial companies (e.g. product design, waste management)
- International organisations
- Management
- Teaching as well as vocational training and continuing education
- Quality assurance
- Service industry (e.g. tourism)
- Scientific Research

The Joint Master's Programme prepares the students for careers in the fields of scientific research. The focus on societal topics of the programme also prepares the students for careers not directly related to scientific research. They can find jobs in the private and public sector (EU, national, regional and local government- and administration level) as well in consulting companies or NGOs. In the course of their future careers, graduates will be able to obtain leading positions, especially in the fields of integration of methodology in the areas of technology and assessment tools (especially related to complex processes in a societal- or technical-industrial field with sustainability components).

§ 2 General Regulations

(1) Allocation of ECTS Credits

Students are awarded ECTS credits for all liable performances. These ECTS credits cover the relative amount of study related performances in which the workload of one year amounts to 1500 real hours which equates to a workload of 60 ECTS credits. This workload includes contact hours and private study.

(2) Duration and Structure of the Programme

The Master Programme with a workload of 120 ECTS credits lasts four semesters, which is equivalent to a duration of study of two years (respectively according to the regulations of the partner universities).

The workload is allocated as follows:

	CS/EC/E	ECTS
Module A: "Basic Knowledge and Systems Sciences"	CS	30
Module B: "Implementation, Management and Design" (incl. Electives)	CS/E	30
Module C: Specialisation Module	CS	30
Module D: Master Thesis		30

CS = Compulsory Subject, EC = Elective Compulsory, E = Electives

The first academic year has to be spent at one of the EU partner countries. The students are allocated to the universities by the following ratio:

- Maximal ten students at the Universities Leiden and Delft
- Maximal ten students at the University of Graz
- Maximal five students at the Chalmers University

In the third semester, students can choose a specialization module at one of the partner universities. Students can spend their fourth semester at one of the partner universities. Attention should be paid to the regulation that each student has to successfully finish at least one semester in two different EU partner countries.

In case EU students intend to study a part of the master programme in the country, where they finished their Bachelor study, they have to study in two further EU partner countries.

The student mobility has to be fully compliant with the regulations of the consortium agreement (§ 13) and the regulations stipulated by the European Commission on Erasmus Mundus Programmes and the regulations stipulated by the scholarship donors.

Students from Third Countries, that hold a scholarship, have to consider that, in compliance with regulations posed by the European Commission on Erasmus Mundus Programmes, a maximum of three months can be spent at a non-EU-University and that not more than 15 ECTS credits can be acquired.

(3) Academic Degree

Students completing the "Erasmus Mundus Master's Programme in Industrial Ecology" will be awarded the degree Master of Science, abbreviated "MSc".

The detailed regulations according Double and Joint Degrees are laid down in the Consortium Agreement (cf. § 16).

The Asian Institute of Technology, Thailand, the Rochester Institute of Technology, USA and the Waseda University, Japan, are mobility partners and award a Diploma Supplement to those students who successfully finish a mobility semester at one or several of these universities.

(4) Course Types

The course types include lectures, seminars, tutorials, exercises and other course types according to the equivalent regulations at partner universities:

- **Karl-Franzens-University Graz:** "Satzungsteil Studienrechtliche Bestimmungen §1 (3)."
  The curriculum includes the following course types
  a. Lectures ("Vorlesungen", VO): Courses, in which the knowledge transfer is achieved by a lecture. The exam is performed in one single act which can be oral or written or written and oral.

b. Courses ("Kurse", KS): Courses, in which the students work together with the lecturers to compile the topic in an experience- and practice- oriented way.
c. Proseminars ("Proseminare", PS): pre-stage to seminars. The courses impart basic knowledge in scientific practice, introduce to scientific literature and exemplify problems of the topic through presentations, discussions and case studies.
d. Seminars ("Seminare", SE): Seminars serve a scientific discussion. The students have to make their own contributions. Generally, seminars are concluded with a written paper.
e. Lectures with exercises ("Vorlesungen verbunden mit Übungen", VU): Related examples and concrete exercises are shown according to the goals of the master programme (according to § 1 section 3 Z 3 lit. a "Satzungsteil Studienrechtliche Bestimmungen").
f. Working groups ("Arbeitsgemeinschaften", AG): Working groups are intended to collaboratively work on concrete topics, methods and techniques of science and to introduce the students to scientific collaboration in small groups.

All course types listed under b. to f. are courses with immanent examination character.

The course types of the six partner universities are listed in their respective study law provisions.

(5) Limitation of Places in Courses

a. Limitations on the number of participants in the individual types of courses may apply for educational and/or safety reasons. Thereby the regulations of the curricula used for this master programme are to be applied.

If the number of participants in the individual types of courses is restricted for educational and/or safety reasons according to the regulations of the partner universities, this accounts for all students.

b. If a sufficient supply of parallel-courses is not possible due to logistical reasons, and the maximum number of students is exceeded, students are accepted according to the regulations of the curricula used for this master programme.

§ 3 Teaching and Learning Methods

In addition to regular teaching and learning forms, blocked courses - e.g. Summer- or Winterschools, Intensive Programmes - can be used to complete the programme after formal approval.

§ 4 Composition and Formation of the Programme

(1) Modules and Courses

The four-semester master's programme comprises 120 ECTS credits in total. The courses have a modular structure. In the following, the courses are named by Title, Type (cf. § 2 article 4 for abbreviations of course type), ECTS credits (ECTS), contact hours (ConH), and the recommended semester assignment (Reco. Sem.). In the column *compulsory subject (CS)* and *elective compulsory (EC) subject* respectively, it is

indicated whether it is a compulsory subject or an elective compulsory subject. Choosing from the elective compulsory subjects is done in accordance with the specifications. E is the abbreviation for *Electives*.

The module descriptions can be found in Annex I.

Module A.1	**"Basic Knowledge and Systems Sciences" (Graz)**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
A.1.1	Systems modelling	VO	3	CS	2	1
A.1.2	Systems integration and assessment	VO	3	CS	2	1
A.1.3	Seminar on systems modelling	SE,PS	4	CS	2	1
A.1.4	Seminar on systems integration and assessment	SE, PS	4	CS	2	1
A.1.5	Environmental and technology assessment	KS	4	CS	2	1
A.1.6	Waste and recycling	KS	4	CS	2	1
A.1.7	Selected topics in sustainable tourism	VO	8	EC	4	1
A.1.7	Selected topics in sustainable tourism	SE	8	EC	4	1
	Sum		30		16	
Module A.2	**"Basic Knowledge and Systems Sciences" (Leiden, Delft)**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
A.2.1	Fundamentals of systems, data, models and computational thinking	KS	6	CS		1
A.2.2	General introduction to Industrial Ecology	KS	6	CS		1
A.2.3	System earth	KS	6	CS		1
A.2.4	Analytical methodologies and tools	KS	6	CS		1
A 2.5	Renewable energy systems	KS	6	CS		1
	Sum		30			
Module A.3	**"Basic Knowledge and Systems Sciences" (Gothenburg)**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
A.3.1	Science of environmental change	KS	7,5	CS		1
A.3.2	Technical change and the environment	KS	7,5	CS		1
A.3.3	Sustainable development	KS	7,5	CS		1
A.3.4	Environmental systems analysis	KS	7,5	CS		1
	Sum		30			
Module B.1	**"Implementation, Management and Design" (Graz)**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
B.1.1	Sustainability Entrepreneurship	KS	4	CS	2	2
B.1.2	Product and Service Development	KS	4	CS	2	2
B.1.3	Eco-Controlling	KS	4	CS	2	2
B.1.4	Strategic Sustainability Management	KS	4	CS	2	2
B.1.5	Value Chain Management	KS	4	CS	2	2
B.1.6	Selected Topics of Sustainability and Innovation Management	KS	4	CS	2	2
	Electives		6	E		
	Sum		30		12+E	
Module B.2	**"Implementation, Management and Design" (Leiden, Delft)**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
B.2.1	Design of sustainable technological systems	KS	6	CS		2
B.2.2	Social systems – policy and management	KS	6	CS		2
B.2.3	Sustainable innovation and social change	KS	6	CS		2
B.2.4	Urban environments and infrastructures	KS	6	CS		2
B 2.5	Electives (e.g. Summer School)		6	E		2
	Sum		30			
Module B.3	**"Implementation, Management and Design" (Gothenburg)**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
B.3.1	Environmental management	KS	7,5	CS		2
B.3.2	Environmental policy instruments	KS	7,5	CS		2
B.3.3	Life cycle assessment	KS	7,5	CS		2
B.3.4	Applied Industrial Ecology	KS	7,5	CS		2
	Sum		30			
Module C.1	**Specialisation module Graz** "The human dimension of Industrial Ecology – Decision-making models and sustainability assessment"	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
C.1.1	Environmental Decision Making	KS	4	EC	2	3

C.1.2	Integrated Management Systems	KS	4	EC	2	3
C.1.3	Selected topics in sustainable urban and regional development	VO	8	EC	4	3
C.1.3	Selected topics in sustainable urban and regional development	SE	8	EC	4	3
C.1.4	Sustainable Innovation	VU	4	EC	2	3
C.1.5	Interdisciplinary practical training	AG	10	EC	6	3
	Sum		30		16	
Module C.2	**Specialisation module Leiden, Delft** “Industrial Ecology methods and tools, in particular modeling certain material systems”	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
C 2.1	Interdisciplinary project groups	AG	12	EC		3
C 2.2	Graduation preparation module	SE	6	EC		3
C 2.3	Advanced course on life cycle assessment	KS	4	EC		3
C 2.4	Electives		8	E		3
	Sum		30			
Module C.3	**Specialisation module Gothenburg** “Sustainable technical systems”	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
C 3.1	Sustainable energy futures	KS	7,5	CS		3
C 3.2	Industrial energy systems	KS	7,5	EC		3
C 3.3	Environmental impact assessment	KS	7,5	EC		3
C 3.4	Fuel cells – functions and materials	KS	7,5	EC		3
C 3.5	Project management for sust. development	KS	7,5	EC		3
C 3.6	Waste management	KS	7,5	EC		3
C 3.7	Strategic environmental assessment	KS	7,5	EC		3
C 3.8	Assesing sustainability	KS	7,5	EC		3
	Sum		30			
	C 3.1 is compulsory, three courses are to choose from C 3.2-3.8 (sum: 30 ECTS credits)					
Module C.4	**Specialisation module AIT** “Asian perspective on Industrial Ecology, technology issues in Industrial Ecology”	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
C 4.1	Natural resources management issues in Asia	KS	2.5	EC		3
C 4.2	Health, development and environment	KS	5	EC		3
C 4.3	Principles of cleaner production	KS	5	EC		3
C 4.4	Integrated natural resources planning and policy	KS	7.5	EC		3
C 4.5	Rural and regional development	KS	7.5	EC		3
C 4.6	Rational use of energy in industry	KS	7.5	EC		3
C 4.7	Gender, technology and development	KS	2.5	EC		3
	Sum		30			
	From C 4.1-7, courses with an amount of 30 ECTS credits are to choose from					
Module C.5	**Specialisation module RIT** “Alternative energy and decision analysis“	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
C 5.1	Economics of sustainability	KS	4	EC	4	3
C 5.2	Technology, policy and sustainability	KS	4	EC	4	3
C 5.3	Understanding risk from multiple sustainability perspectives	KS	4	EC	4	3
C 5.4	Multi-criteria sustainable systems analysis	KS	4	EC	4	3
C 5.5	Climate change science and solutions	KS	4	EC	4	3
C 5.6	Sustainable product design	KS	4	EC	4	3
C 5.7	Applied life cycle assessment	KS	3	EC	3	3
C 5.8	Materials cycling – closing the loop	KS	3	EC	3	3
	Sum		30			
Module C.6	**Specialisation module Waseda University** “Industrial Ecology methods based on input output analysis, with special emphasis on waste and resource management”	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**
C 6.1	Industrial Ecology	KS	4	EC		3
C 6.2	Topics in Industrial Ecology	KS	4	EC		3
C 6.3	Joint workshop on Industrial Ecology	KS	4	EC		3
C 6.4	Input-output analysis/econometrics	KS	4	EC		3
C 6.5	Topics in input-output analysis/econometrics	SE	2	EC		3
C 6.6	Environmental economics	KS	4	EC		3
C 6.7	Sustainable resource management	KS	4	EC		3
C 6.8	Introduction to resources processing and recycling	KS	4	EC		3
	Sum		30			
Module D.1	**Master thesis Graz**	**Type**	**ECTS**	**CS/EC/E**	**ConH**	**Reco. Sem.**

D.1.1	Master examination		2			4
D.1.2	Master thesis		28			4
Module D.2	Master thesis Leiden, Delft					
D.2	Thesis Research Project		30			4
Modules D.3-6	Master thesis Gothenburg, AIT, RIT, Wasdeda University					
D.3-6	Master thesis		30			4

(2) Requirements for Attending Modules/Courses

Except for the entry requirements mentioned (see § 1 section 3), there are no such requirements.

(3) Electives

During the entire duration of the master's programme electives have to be completed (to an extent of 6 ECTS credits for Graz and 14 ECTS credits for Leiden/Delft). These can be freely chosen from the curriculum of all recognized national and international universities as well as all national universities of applied science and colleges of education. They are used to impart knowledge and abilities both from closely related areas to the own subject and areas of general interest.

It is recommended to choose the electives through a profession-oriented practical training or from courses of the areas project management, social competences, foreign languages or Summer School (3 ECTS credits).

(4) Master Thesis

The module master thesis incl. master examination comprises 30 ECTS credits. The master thesis serves to demonstrate the ability to do scientific research in an autonomous way and justifiable regarding contents and methodology. The master thesis must be written in English. For the conduction and the grading of the master thesis, the applicable statutes of that partner university concerned are effective, where the master thesis will be elaborated.

a. The student announces the topic of his or her master thesis and his or her advisor in written form before the inception of the master thesis. The topic and the advisor are accepted, unless it will be prohibited within one month after the student's announcement. Until the submission of the master thesis, the student is allowed to change his or her advisor.
b. It is recommended that the master thesis is written during the fourth semester.
c. For the supervision of the master thesis, the provisions of the university of admission apply.
d. The topic of the master thesis is to be taken from one of the following modules or needs to have a meaningful relation to one of these subjects.

Module C	Specialisation module
C.1	The human dimension of Industrial Ecology – Decision-making models and sustainability assessment
C.2	Industrial Ecology methods and tools, in particular modeling certain material systems
C.3	Sustainable technical systems
C.4	Asian perspective on Industrial Ecology, technology issues in Industrial Ecology
C.5	Alternative energy and decision analysis
C.6	Industrial Ecology methods based on input output analysis, with special emphasis on waste and resource management

e. The student is entitled to propose a topic or to choose from a number of proposals of the available supervisor.
f. The objective of the master thesis must be chosen so that the completion of the work is accomplishable and reasonable within six months for the student.
g. The grading of the master thesis is documented through a certificate.

(5) Practice and Obligatory Study Abroad

a. Recommended Practice

Students can conduct a profession-oriented practical training in the context of their electives. The maximum amount of that practical training is four weeks on a full-time basis, which is equivalent to 6 ECTS credits. The practical training has to be approved beforehand by the competent bodies and has to be a meaningful amendment to the master programme.

b. Obligatory Study Abroad

The students are advised to spend at least one semester at two different EU partner countries. The regulations of the European Commission for Erasmus Mundus Programmes have to be considered. For their mobility plans the students have to hand in preference lists for the first study year (first and second choice), which has to be completed in one of the three EU countries, as well as for the third and fourth semester (each first, second and third choice). The Admission Committee decides on the mobility plans according to the availability of vacancies. It is assumed, that all general and specific requirements for the study programme are fulfilled by the time of the nomination by the university of admission.

§ 5 Examination Regulations

(1) The performance of students is judged with the help of several methods, including exams and written work according to the regulations of the partner universities.

(2) The Master Exam is conducted by a commission. This exam can only be taken when all necessary compulsory and elective courses have been successfully completed and when the master thesis has been successfully finished as well.
The examination senate consists of three members, one of which has to be elected as chairperson. For every examination subject there has to be one examiner.
The subject of the Master exam is the public defense of the master thesis and the subject on which it was written.

(3) Grading Systems
Every partner university uses the grading system according to its relevant regulations. A conversion table is provided in Annex III.

(4) Evaluation and Quality Assurance

For quality assurance in all respective areas of the programme, the consortium members will set up a Evaluation Committee for internal, and an international Evaluation group for external quality assurance. The members of those committees and the regulations for the evaluations are laid down in the Consortium Agreement (see its §12).

The Programme Board is in charge of the overall administration of the programme and the quality assurance.

§ 6 Coming into Effect of the Curriculum

The present curriculum comes into effect at the partner universities mentioned above according to their commitment at the beginning of the academic year 2011/2012 following its approval by the respective responsible authorities.

Annex I: Description of Modules

Module A	**"Basic Knowledge and Systems Sciences"**
ECTS credits	30
Content	▪ Systems modelling ▪ Systems integration (of concepts and models in natural and social sciences) ▪ Systems assessment ▪ Sustainability ▪ Environmental assessment ▪ Technology assessment ▪ Management of resources and waste management ▪ Sustainable tourism ▪ Renewable energy systems
Learning objectives (expected learning results and acquired competences)	<u>Professional and methodological competences;</u> After completing the module, students are able ▪ to model systems ▪ to understand scenarios and concepts in order to integrate natural and social sciences and to apply those to case studies ▪ to analyse, understand und assess systems from a sustainability perspective ▪ to conduct environmental and technology assessments ▪ to analyse resource, waste management and recycling systems ▪ to develop sustainable tourism concepts and renewable energy systems <u>Social and personal competences:</u> After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Lecture; homework; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Module B	**"Implementation, Management and Design"**
ECTS credits	30
Content	• Integration of sustainability aspects into business management • Analysis and systematization of sustainability strategies • Development and implementation of sustainable business strategies • Influence of organisations culture • Standards, tools and methods of environmental controlling • Analysis of planning, steering and controlling of the ecological business performance • Environmental reporting • Ecological entrepreneurship in the context of sustainable development • Analysis and preparation of business plans

	• Modern aspects of designing product development processes • Urban infrastructures • Policy instruments
Learning objectives (expected learning results and acquired competences)	<u>Professional and methodological competences;</u> After completing the module, students are able • to understand sustainability management approaches, different sustainability strategies and the application of management tools • to create a tailor-made sustainability management according to the specific context • to develop sustainability strategies • to apply sustainable management tools • to analyse and reflect the implementation of sustainability strategies (e.g. in terms of designing an effective and eco-efficient business performance) • to conduct process related sustainability analyses for certain product developments • to apply stakeholder analysis, systems creation and scenario technique concerning entrepreneurship and development of services and products • to prepare business plans • to perform the analysis, reflection and design of product development processes • to assess urban infrastructures • to apply policy instruments in the context of Industrial Ecology <u>Social and personal competences:</u> After completing the module, students are able • to work in interdisciplinary teams and to design negotiation procedures • to reflect individual and collaborative problem solving processes in a holistic way • to design communication processes for particular stakeholders • to design and to critically analyse interaction processes between experts and stakeholders • to understand complex problems in a holistic way • to handle self-management
Teaching methods, learning activities	Talk; case studies; individual and group work based on case studies; reflection and discussion; speeches of practitioners; excursions; homework; collaboration; elaboration of selected literature; conducting scientific papers; survey
Offered	*Yearly*

Module C.1	**Specialisation module: "Human Dimension of Industrial Ecology"**
ECTS credits	30
Content	▪ Environmental decision-making ▪ Integrated management systems ▪ Sustainable urban and regional development ▪ Sustainable innovation ▪ Interdisciplinary cooperation
Learning objectives (expected learning results and acquired competences)	<u>Professional and methodological competences;</u> After completing the module, students are able ▪ to analyse the human influence in different problem contexts ▪ to understand and to model factors, that influence human

	activities related to the environment ▪ to develop concepts of sustainable urban and regional development with a special emphasis on decision-making ▪ to develop sustainable innovation concepts ▪ to initiate an interdisciplinary project, to elaborate its relevant issues and to develop solution approaches Social and personal competences: After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Group work; lecture; homework; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Module C.2	**Specialisation module: "Industrial Ecology methods and tools, in particular modeling certain material systems"**
ECTS credits	30
Content	▪ Interdisciplinary cooperation ▪ Detailed knowledge concerning life cycle analysis ▪ Application of Industrial Ecology tools ▪ Modelling of material and substance flows ▪ Preparation of Master Thesis
Learning objectives (expected learning results and acquired competences)	Professional and methodological competences; After completing the module, students are able ▪ to initiate an interdisciplinary project as a team, to elaborate its relevant issues and to develop solution approaches ▪ to understand in theory and practice and to fully apply life cycle analysis ▪ to understand and to model factors, that influence human activities related to the environment ▪ to use Industrial Ecology tools related to the problem context and the desired objectives ▪ to adequately prepare the Master Thesis Social and personal competences: After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Group work; lecture; homework; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Module C.3	**Specialisation module: "Sustainable technical systems"**
ECTS credits	30
Content	▪ Sustainable technical systems, particularly in the energy sector ▪ Assessment methodology regarding environmental and sustainability issues ▪ Project management for sustainable development
Learning objectives (expected learning results and acquired competences)	Professional and methodological competences; After completing the module, students are able ▪ to analyse the human influence in different problem contexts ▪ to understand and to assess factors, that influence human activities related to the environment ▪ to develop technical systems, particularly in the energy sector ▪ to understand and to apply project management methods in a target-oriented way Social and personal competences: After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Lecture; home work; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Module C.4	**Specialisation module: "Asian perspective on Industrial Ecology, technology issues in Industrial Ecology"**
ECTS credits	30
Content	▪ Asian perspective of Industrial Ecology ▪ Technology issues in Industrial Ecology (e.g. rational use of energy in industry, cleaner production) ▪ Resources planning and management ▪ Rural and regional development
Learning objectives (expected learning results and acquired competences)	Professional and methodological competences; After completing the module, students are able ▪ to analyse the human influence in different problem contexts ▪ to understand and to assess factors, that influence human activities related to the environment, focusing on the Asian perspective ▪ to develop concepts of sustainable rural and regional development ▪ to classify and to understand technology issues in Industrial Ecology (e.g. concerning cleaner production or the rational use of energy and resources in industry) Social and personal competences: After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and

	to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Lecture; home work; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Module C.5	**Specialisation module: "Alternative energy and decision analysis"**
ECTS credits	30
Content	▪ Risk assessment in the sustainability context ▪ Economic aspects of sustainability ▪ Sustainable systems analysis ▪ Circular flow economy ▪ Renewable energy ▪ Decision-making analysis
Learning objectives (expected learning results and acquired competences)	Professional and methodological competences; After completing the module, students are able ▪ to analyse the human influence in different problem contexts ▪ to understand and to assess factors, that influence human activities related to the environment, focusing on the Asian perspective ▪ to conduct risk assessments ▪ to develop economic sustainability concepts (e.g. concerning circular flow economy or renewable energy) Social and personal competences: After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Lecture; home work; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Module C.6	**Specialisation module: "Industrial Ecology methods based on input output analysis, with special emphasis on waste and resource management"**
ECTS credits	30
Content	▪ Input-output analysis ▪ Econometrics ▪ Environmental economics ▪ Resource management ▪ Waste management
Learning objectives (expected learning results and acquired competences)	Professional and methodological competences; After completing the module, students are able ▪ to analyse the human influence in different problem contexts ▪ to understand, to model and to assess factors, that influence

	human activities related to the environment, focusing on the Asian perspective ▪ to conduct input-output analyses, focusing on resource and waste management ▪ to understand and to properly apply methods of econometrics ▪ to develop approaches in the field of environmental economics <u>Social and personal competences:</u> After completing the module, students are able ▪ to research and elaborate scientific literature ▪ to present findings both in oral and written form ▪ to work in an interdisciplinary manner ▪ to critically question ideas and models, to assess those and to develop new ones ▪ to design the continuative learning process in a autonomous manner
Teaching methods, learning activities	Lecture; home work; collaboration; elaboration of selected literature; computer based demonstrations; conducting scientific papers; exemplification of concepts
Offered	*Yearly*

Annex II: Curriculum's Example

Semester	Title of course	ECTS
1	Basic Knowledge and Systems Sciences	
A.1.1	Systems modelling	3
A.1.2	Systems integration and assessment	3
A.1.3	Seminar on systems modelling	4
A.1.4	Seminar on systems integration and assessment	4
A.1.5	Environmental and technology assessment	4
A.1.6	Waste and Recycling	4
A.1.7	Selected topics in sustainable tourism	8
Sum		30
2	Implementation, Management and Design	
B.1.1	Sustainability Entrepreneurship	4
B.1.2	Product and Service Development	4
B.1.3	Eco-Controlling	4
B.1.4	Strategic Sustainability Management	4
B.1.5	Value Chain Management	4
B.1.6	Selected Topics of Sustainability and Innovation Management	4
	Electives	6
Sum		30
3	Specialisation modules	
	Every student has to choose one specialisation module and has to do it at a university different from the one, where he or she spent his or her first study year	
Module C.1	The human dimension of Industrial Ecology – Decision-making models and sustainability assessment	
Module C.2	Industrial Ecology methods and tools, in particular modeling certain material systems	
Module C.3	Sustainable technical systems	
Module C.4	Asian perspective on Industrial Ecology, technology issues in Industrial Ecology	
Module C.5	Alternative energy and decision analysis	
Module C.6	Industrial Ecology methods based on input output analysis, with special emphasis on waste and resource management	
Sum		30
4	Module Master Thesis	
D.1.1	Master Examination	2
D.1.2	Master Thesis	28
Sum		30

Annex III: Grading Systems

ECTS grades	Definition (German)	Definition (English)	Equivalent Graz	Equivalent Delft, Leiden	Equivalent Waseda	Equivalent Chalmers	Equivalent AIT, RIT
A	Ausgezeichnete Leistungen und nur wenige unbedeutende Fehler	Outstanding performance with only minor errors	(1) very good	10 – 8.5	A	5	A
B	Überdurchschnitt-liche Leistungen, aber einige Fehler	above the average standard but with some errors	(2) good	8.0 – 7.5	A	4	B
C	Insgesamt gute und solide Arbeit, jedoch mit einigen grundlegenden Fehlern	generally sound work with a number of notable errors	(3) satisfactory	7.0	B	4	C
D	Mittelmäßig, jedoch deutliche Mängel	fair but with significant shortcomings	(4) fair/pass	6.5	C	3	D
E	Die gezeigten Leistungen entsprechen den Mindest-anforderungen	performance meets the minimum criteria	(4) fair/pass	6.0 – 5.5	No equivalent	3	E
F	Es sind erhebliche Verbesserungen erforderlich, nicht bestanden	Considerable further work is required, failed	(5) failed	5 - 4 - 3 - 2 - 1	D	<3	F