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FOREST Atlas of Best Practices

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Innehåll

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Best practice survey Instituto Politécnico de Tomar (IPT)

No.	Topic/ Issue	Questions	Answers
1	Program Name	What is the name of your Master program?	Chemical Technology
2	Target group	What are the target groups/ potential students?	The potential students are graduated in Sciences and Engineering, that wish to acquire in dept knowledge in chemical technology; some are already working and want to update their knowledge
3	Admission requirements	What are the admission requirements for your program?	Holders of a Bachelor degree or equivalent in chemical and biological technology related areas such as chemical, biochemical, food and environmental sciences
4	Required prerequisite knowledge	What are the required prerequisite knowledge that the student(s) must have to fullfil the admission?	They must have a good background in basic sciences (mathematics, physics and chemistry) and also in applied sciences; also it is valorized an academic, scientific or professional curriculum in chemical and biological areas
5	Study programme's relevance	What is the relevance/ advantages/ strengths of your MSc study program?	The advantages are the good ratio student/teatcher and the emphasis on practical aspects
6	Program objectives	What are the objectives of your MSc program?	The MSc program was designed to allow students to enter the labor market, or pursue higher studies, PhD
7	Career opportunities	What are the career opportunities for your graduate students? What type of job he/she can do?	Holders of the master´s degree in Chemical Technology are prepared to perform as: Production managers or production assistant managers within chemical and biological industries; Manager or assistant managers of industrial premises related with chemical technology such as industrial utilities and industrial wastewater treatment plants; Members of multidisciplinary teams for the creation, implementation or optimisation of chemical and biological industries; Director or middle manager within independent or auxiliary chemical and biological laboratories

8	Learning Outcome	What are the learning outcomes of your MSc program?	Graduates from this master´s program are expected to be able to: Apply mathematical and engineering concepts and techniques,specially those applied to chemical technology and chemical engineering; Define, model and solve problems related with chemical, biological and environmental processes; Prepare and implement experiments and tests and be able to interpret and use respective results; Use advanced analyses techniques and computer methods in chemical engineering; Join project or research teams involved in process development and promote interdisciplinary tasks; Promote the development of sustainable processes, clean technologies and rational energy use; Design, implement, manage and optimise industries engaged in chemical and biological processes and their key support systems, including waste water management and treatment; Evaluate, from the technical, economical and environmental point of view, new products and production technologies; Apply the quality control procedures to raw materials and products; Plan, draw up, implement and coordinate quality control methodologies as applied to production processes, laboratories and associated industrial services; Acquire individual and teamwork methodologies that will allow them to engage in lifelong learning activities
9	Indicators of competence achievement	What are the Indicators to achieve the competence by the students?	Assessment of course units complies with the Academic Regulations; the assessment can be made by writen exams, pratical examinations or monographic papers.
10	Academic content and description of the study programme	Please provide the description of the MSc programme and contents of subjects in the training program.	The master's degree was designed so as to develop skills in the following technical-scientific areas: Chemical Technology (62 compulsory and 12 optional ECTS credits); Industrial Processes (12 compulsory and 16 optional ECTS credits); Environment and Quality (12 compulsory ECTS credits); Physical and Inorganic Chemistry (6 compulsory ECTS credits); Organic Chemistry and Biotechnology (6 compulsory ECTS credits); Mathematics (6 compulsory ECTS credits).
11	Study tracks	How many study tracks do you have? How can you decide the subject area to be studied in depth?	Does not apply
12	Practice types	What kind of practices (beside lab works) that your MSc students will take for each subject?	Students must perform individual research in given topics, and they should be able to present the results to teatchers and colleagues.

13	Final examination and assessment	How do you organize the final exam and assessment?	The students must develop an original project or undertake professional internship and associated report. Both the project and the internship report must be submitted for appreciation to an examination panel appointed for that purpose.
14	Electives	How many electice subjects (and its credits) are there in your MSc program?	Completion of the program requires a pass in all its constituent modules including the preparation and public defence of scientific dissertation, project work or internship report so as to accumulate 120 ECTS credits, of which 104 are compulsory and 16 are selected among optional modules available in the curriculum
15	Requirements for the teaching staff / program manager	What are the minimum requirements for the teaching staff / program manager? (In term of their qualifications and experiences; The autonomy of the professor to take lead on research	The degree program coordinator must hold a PhD in the field of Chemical Technology.
16	External assessment of the educational activities quality	How do you do with external assessment?	The degree program is avaliated and subject of accredditation by a National Agency.
17	Some special features	What are the special features of your MSc program?	The emphasis in the solution of pratical problems and the critical thinking development.
18	Risks, challenges to develop the MSc program	Is there any risks/ challenges you may face from the beginning to develop the MSc program? If Yes, how can we realize/detect them? What is the indicator? And How can you solve them (if any)?	Difficulty in finding quality students with a vocation for the field of chemical technology. We try to meet undergraduate students and recruit the best.

19	Identifying the training NEED and learning outcomes	How can we identify the training NEED and learning outcomes that fit with the future labor market? We need a good forecast of future labor market, but these info is difficult to obtain in developing countries like us. We are now running the survey via Questionnaire. but less/few feedback/ response is a big problem. What do you recommend/ advice? How to continue, How to solve, How to encourage "potential employers/ future students" to get involved in this process?	Internally, questionnaires are carried out regularly. For external partners, a personal approach is best, that is developing partnerships with companies for internships for example.
20	The partnership with industry/ students associations	What do we have to take care of while starting a new program? Is the partnership with industry/ students associations needed? How can you develop such a good partnership?	See as 22.

21	Difference/ Gaps between the university expertise/ resources and young generation's "taste"/ desire	Basically, we only can develop a GOOD training program based on our expertise/ resources and fit future labor market demand, BUT the training program must fit with the young generation's "taste"/ desire too. How does the EU partners deal with such optimization problems that are often opposite?	Have a mix on that. We need to atract students with the prespective of multiple professional opportunities, meeting different vocations, more in the industry for some, and more in laboratory for others.

Best practice survey Linköping University (LiU)

No.	Topic/ Issue	Questions	Answers
1	Program Name	What is the name of your Master program?	MSc in Science for Sustainable Development
2	Target group	What are the target groups/ potential students?	Interdisciplinary, mainly environmental science, political science, geography, planning, etc.
3	Admission requirements	What are the admission requirements for your program?	Bachelor's degree equivalent to a Swedish Kandidatexamen in one of the following areas: - natural sciences, - social sciences, - humanities or - engineering 15 ECTS credits passed in Environmental Sciences, Sustainable Development or equivalent English corresponding to the level of English in Swedish upper secondary education (English 6/B) (Exemption from Swedish)
4	Required prerequisite knowledge	What are the required prerequisite knowledge that the student(s) must have to fullfil the admission?	See question 3.
5	Study programme's relevance	What is the relevance/ advantages/ strengths of your MSc study program?	Commited students from a very varied disciplinary and socioeconomic/geographical context. Strong connection between research and teaching due to the fact that almost all teachers conduct research on some of the topics they teach
6	Program objectives	What are the objectives of your MSc program?	We do not have an objective per se. The programme gives students an opportunity to explore the complexity of creating sustainable societies in alignment with the principles of sustainable development and Agenda 2030. The programme addresses global environmental changes and societal transformations. It will challenge you to undertake critical analysis of present and future environmental concerns, apply scientific knowledge across academic disciplines, and develop interdisciplinary competence. Your training will enable you to develop skills to interpret, design, communicate, and implement solutions to sustainability and environmental challenges, which will be indispensable for your future career as a sustainable development expert.
7	Career opportunities	What are the career opportunities for your graduate students? What type of job he/she can do?	The programme provides a strong basis for a career related to sustainable development and environmental sciences. Our graduates have positions in research institutes, universities, environmental organisations, businesses, NGOs, river basin commissions, consultancies, power companies, intergovernmental environmental agencies, and PhD programmes around the globe.

8	Learning Outcome	What are the learning outcomes of your MSc program?	On completion of the program the students will have developed an independent and critical approach to environmental science and sustainability studies and have acquired skills and knowledge that will enable them to actively work in and contribute to developments in these fields, either as practioners or researchers. The programme also fulfils the students` eligibility for doctoral education in related fields. For a Degree of Master (120 credits) the student shall: (Knowledge and understanding) demonstrate knowledge and understanding in environmental science, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work, and demonstrate specialised methodological knowledge in environmental science. (Competence and skills): demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information; demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work; demonstrate the ability in speech and writing both nationally and internationally to clearly report and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences; and demonstrate the skills required for participation in research and development work or autonomous employment in some other qualified capacity. (Judgement and approach) demonstrate the ability to make assessments in environmental science informed by relevant disciplinary, social and ethical issues and also to demonstrate awareness of ethical aspects of research and development work; demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used; and demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning. For each course there are 4-6 specific Intended Larning Objectives.
9	Indicators of competence achievement	What are the Indicators to achieve the competence by the students?	Very hard question to answer. The degree to which all Intended Learning Objectives for the specific courses contribute to the overall competencies is self-indicated. All individual learning objectives are examined and graded according to ECTS scale.

10	Academic content and description of the study programme	Please provide the description of the MSc programme and contents of subjects in the training program.	1. Unique environment: We are one of few universities to offer a broad interdisciplinary perspective of environmental sciences, from humanities to social- and natural sciences. Courses are designed in close dialogue with potential employers as well as students to ensure that the contents address current environmental problems and future challenges. 2. Strong research links: The connection between the programme and research is strong, as all teachers engage in environmental and sustainability research. This ensures teaching of the latest theoretical and methodological knowledge and research findings. 3. High-quality teaching: The teachers continuously work on improving the quality of their courses according to student feedback and discussions with student representatives in the programme Council. 4. High teacher-student ratio: This high ratio ensures rapid and personal feedback from teachers, close interaction between teachers and students and student-active learning. 5. Strong professional links: Through casework and learning activities, students engage with individuals in nearby environmental authorities and research institutes and concretely work with real-world problems and societally relevant issues. 6. Problem-based activities: Students acquire a broad set of competencies throughout the programme. They also have opportunity to specialise in social sciences, natural sciences or humanities. A vast majority of our students have an environment-relevant job or continue within academia within one year of graduation. 7. Student-centred/active learning: Student-centred learning activities include exercises in the Norrköping Decision Arena that makes use of visualisation as a strong tool for interaction and decision-making, role-play where students represent organisations with different perspectives and interests in actual issues, and various types of communication techniques. Curriculum: Semester 1: Critical Perspectives on Sustainable Development, (7.5hp); Environmental and Resource Use Challenges (7.5hp); Our changing planet (7.5hp); Environmental politics and governance (7,5hp). Semester 2: Climate Sciences (7.5 hp); Sustainability Transformations - the personal, the practical and the political (7.5 hp); Sustainable Resources Management (7,5hp); Designing Environmental Studies (7.5hp). Semester 3 (electable courses): Visualizing Sustainability Challenges and Pathways (7.5hp); Sustainability in the Urban Realm: city/ neighbourhood/home (7.5hp); Research Skills in Environmental Science I (7.5hp); Research Skills in Environmental Science II (7.5hp); Internship in Environmental Science (15hp) & (30hp). Semester 4: Exam thesis (Master-thesis).
11	Study tracks	How many study tracks do you have? How can you decide the subject area to be studied in depth?	Only one track but students elect courses in semester 3.

12	Practice types	What kind of practices (beside lab works) that your MSc students will take for each subject?	Field trips, exercises in the Norrköping Decision Arena, workshops, etc.
13	Final examination and assessment	How do you organize the final exam and assessment?	In a specific course with seminars on what constitutes a "good" thesis. Students suggest supervisor from our faculty or with specialised competence. Two time slots for submission. All theses are presented, critically evaluated by a treacher and another student.
14	Electives	How many electice subjects (and its credits) are there in your MSc program?	One semester (20 weeks, 30 hp)
15	Requirements for the teaching staff / program manager	What are the minimum requirements for the teaching staff / program manager? (In term of their qualifications and experiences; The autonomy of the professor to take lead on research	Program manager: Permanent employment, senior lecturer or above. Most teachers have a PhD but PhD candidates also are involved in teaching.
16	External assessment of the educational activities quality	How do you do with external assessment?	This is organised by the Philosophical Faculty and the Swedish Council for Higher Education. I think we´re evaulated every sixth year - we just did it. The evaulation consists of a self-assessment and interviews/hearings. Based on that the programme develops an action plan for improvements.
17	Some special features	What are the special features of your MSc program?	See question 10.
18	Risks, challenges to develop the MSc program	Is there any risks/ challenges you may face from the beginning to develop the MSc program? If Yes, how can we realize/detect them? What is the indicator? And How can you solve them (if any)?	Importance of setting a common, shared overall goal. Think about in what way the programme will comply with national objectives/skills. Assign a core group that develops the programme syllabus and draft outlines of individual courses. To ensure that there is a red tread throughout the programme and that individual courses are not too diverse/divergent.

19	Identifying the training NEED and learning outcomes	How can we identify the training NEED and learning outcomes that fit with the future labor market? We need a good forecast of future labor market, but these info is difficult to obtain in developing countries like us. We are now running the survey via Questionnaire. but less/few feedback/ response is a big problem. What do you recommend/ advice? How to continue, How to solve, How to encourage "potential employers/ future students" to get involved in this process?	We collected information from a range of potential employees, formed a "External partner council", surveyed alumni. In your case, I'd suggest doing about ten interviews digitally to collect more qualitative material and ensure sufficient "replies".
20	The partnership with industry/ students associations	What do we have to take care of while starting a new program? Is the partnership with industry/ students associations needed? How can you develop such a good partnership?	Our experience is that a few core partners are a good starting point (to allow for practical cases, internships etc.). More partners can then be added over time.
21	Difference/ Gaps between the university expertise/ resources and young generation's "taste"/ desire	Basically, we only can develop a GOOD training program based on our expertise/ resources and fit future labor market demand, BUT the training program must fit with the young generation's "taste"/ desire too. How does the EU partners deal with such optimization problems that are often opposite?	There are lots of opportunities to allow for studies abroad (the electable semester) in partner universities. The European Union is also developing courses within the ECIU platform. So we can get some external competence. We can also contract other parts of our University and teachers from other universities to come extent. Moreover, we have learnt that competence "about the specific topic" is often quite easily obtained/developed. Our teachers have generic skills in doing that. So allowing for developing those skills is effective (and achieved by using competence development time for that).

Best practice survey Montanuniversität Leoben (MUL)

No.	Topic/ Issue	Questions	Answers
1	Program Name	What is the name of your Master program?	Raw materials engineering
2	Target group	What are the target groups/ potential students?	It serves to deepen and supplement the academic professional training based on the bachelor's degree in raw materials engineering and to qualify for professional activities in the raw material extraction and raw material processing industry, which require the application of scientific knowledge and methods.
3	Admission requirements	What are the admission requirements for your program?	mechanical engineering
4	Required prerequisite knowledge	What are the required prerequisite knowledge that the student(s) must have to fullfil the admission?	General and analytical chemistry General physics Mathematics and statistics Computing and data sciences Mineralogy and general geochemistry General knowledge in mining
5	Study programme's relevance	What is the relevance/ advantages/ strengths of your MSc study program?	The strength is the specification in raw material extraction and processing
6	Program objectives	What are the objectives of your MSc program?	The Master's degree in raw materials processing is divided into the three main subjects Processing and Finishing, Building Materials and Ceramics, and Mineral Processing and Energy Systems and pursues the general objectives: • Consolidation and scientificization of the training in the main subjects to a level corresponding to the master's degree at a recognized Anglo-Saxon university • Broad, assured skills in the main subjects • Problem-solving skills in your own specialist area and in interdisciplinary ones Questions • Social and leadership skills • Support for the domestic industry by providing graduates who can be employed both nationally and internationally Curriculum Master's degree in raw materials processing 3 • Profiling of the Montan University Leoben as a Central European training center for mineral raw material processing and the building material and ceramic industry • Establishment as an attractive course of study for domestic and foreign students who have already acquired the academic degree of a Bachelor of Science (BSc) in the bachelor's degree in raw materials engineering

7	Career opportunities	What are the career opportunities for your graduate students? What type of job he/she can do?	The job opportunities are within the mining industry, the processing industry as well in the subsequent technologies along the value chain. The borad basic knowledge allows for a variety of technological as well as management functions.
8	Learning Outcome	What are the learning outcomes of your MSc program?	The main learning outcomes of this master's degree consist in deepening and supplementing the theoretical and scientific basics and application-oriented knowledge in the fields of "preparation and finishing" and "building materials and ceramics" as well as knowledge of the legal framework and management.
9	Indicators of competence achievement	What are the Indicators to achieve the competence by the students?	The students have to accomplish in total 120 ECTS of which 68 are compulsory subjects. These have a summative assessment each and all have to be positive. 25 are for the master thesis which is reviewd by the supervisors and a final master exam. Compulory practical courses have 5 ECTS and have to be fullfilled and are evaluated by formative assessments.
10	Academic content and description of the study programme	Please provide the description of the MSc programme and contents of subjects in the training program.	The main subject Building Materials and Ceramics aims to impart technical and scientific knowledge in the area of the structure, properties, manufacture and use of products in the stone industry (mineral binders and building materials, refractory building materials, ceramics and glass). An additional focus is placed in the area of processing and refinement. In addition, graduates should acquire all the knowledge and skills that are necessary for the economic use of technical and scientific principles, in particular problem-solving skills, social skills and leadership skills. The training should be internationally recognized, open up a global field of work, attract students from all countries and therefore also take place in English. Graduates from this major should be prepared for multinational activities in the world of work. The main subject preparation and refinement aims to impart technical and scientific knowledge in the area of chopping, separating (according to grain size or according to physical, physical / chemical and chemical properties) as well as lump-making for primary and secondary solid raw materials. Graduates from this major should be able to manage industrial processing processes and further develop the state of the art. In addition, due to the in-depth engineering training, they should be able to work for solid raw material types of primary (ores, salts, industrial minerals, coal, construction raw materials, etc.) but also of secondary origin (electronic scrap, shredder light fraction, secondary fuels, slag, tunnel excavation, ...) to plan economic processes. They should acquire the ability, based on the characteristics of the raw material and the knowledge of the behavior of the phases and

			adhesions in the different shredding and separating devices, to select, dimension and interconnect optimal devices for the respective task. Training in computer simulation is intended to support these skills. Graduates should be given the tools they need to work as leading and planning engineers in the primary and secondary raw materials industries, in product development and development of processing machines, or in government agencies as well as in science and research to pass. The main subject Mineral Processing and Energy Systems aims to acquire technical and scientific knowledge in the area of comminution, separation (according to grain size, according to physical, physical / chemical and chemical properties) as well as lump-making for primary (coal, uranium ores) and secondary energy resources (secondary fuels)) to convey. Graduates of the master's program should be able to manage industrial processing processes and further develop the state of the art on the basis of their training. In addition, due to the geostatistical focus in France, they are located in the processing chain between mining and processing and can therefore perform tasks of equalizing the feed material and quality management of the Curriculum Master's degree in raw materials processing 4 Accept raw material types (grade control). Graduates should be given the tools they need to work as leading and planning engineers in the energy raw materials industry, to be employed in quality control of mining operations and product development, or to survive in authorities as well as in science and research. The main learning outcomes of this master's degree consist in deepening and supplementing the theoretical-scientific basics and application-oriented knowledge in the fields of "preparation and finishing" and "building materials and ceramics" as well as knowledge of the legal framework and management.
11	Study tracks	How many study tracks do you have? How can you decide the subject area to be studied in depth?	There are three study tracks, The sudents have common compulory subjects and can select subjects ourt of a sepcific framework of courses relevant for the single tracks.

12	Practice types	What kind of practices (beside lab works) that your MSc students will take for each subject?	In order to test and practice-oriented application of the knowledge and skills acquired in the master's course in raw materials processing, a relevant practical course based on the course content must be completed at a suitable, preferably non-university institution with a workload of 5 ECTS credit points (corresponds to 14 working days). (2) Completion of the internship must be confirmed in writing by the company in which the internship was completed, stating the type and duration of the work performed. (3) As a substitute in the event that it is demonstrably not possible to complete the practical training, a guided, application-oriented written thesis must be carried out. The extent is to be adapted to the extent of the practice not provided. The dean of studies determines the details.
13	Final examination and assessment	How do you organize the final exam and assessment?	(1) The prerequisite for admission to the master's examination is the successful completion of all prescribed courses from the compulsory and tied and free elective subjects, the positive completion of the seminar for the master's thesis on raw materials processing as well as the positive assessment of the master's thesis and the successfully completed compulsory practice. (2) The master's examination is to be taken orally in the form of an overall examination in front of an examination senate set up in accordance with the statutes of study law provisions. (3) The final master's examination comprises two examination subjects. The first examination subject is the subject to which the master's thesis is assigned. The second examination subject is determined by the dean of studies. When registering for the exam, the student can make a suggestion for the second exam subject. (4) The master's examination is assigned 2 ETCS credit points. (5) The master's degree is concluded with the successful completion of the master's examination.

14	Electives	How many electice subjects (and its credits) are there in your MSc program?	(1) Students of the major subject preparation and finishing are obliged to complete courses with a total of 8 ECTS credit points from the subject-specific electives listed in Table 5. These bound electives can be freely chosen by the students. (2) Students with a major in building materials and ceramics are required to complete courses with a total of 10 ECTS credits from the subject-specific electives listed in Table 6. These bound electives can be freely chosen by the students. (3) The students of the major subject Mineral Processing and Energy Systems are obliged to complete courses amounting to 8 ECTS credits from the subject-specific electives in Table 7. These bound electives can be freely chosen by the students.
15	Requirements for the teaching staff / program manager	What are the minimum requirements for the teaching staff / program manager? (In term of their qualifications and experiences; The autonomy of the professor to take lead on research	Teaching staff has to be trianed and qualified personnell only with relevant proof of competence (e.g. habilitation) and has to follow regular training.
16	External assessment of the educational activities quality	How do you do with external assessment?	In the quality control mechanisms of external assessment are not specifically froeseen.
17	Some special features	What are the special features of your MSc program?	The masters program provides a very specific training and a high degree of specialization. One main feature is to gain practical exoerience within a company where a practical training has to be obtained.
18	Risks, challenges to develop the MSc program	Is there any risks/ challenges you may face from the beginning to develop the MSc program? If Yes, how can we realize/detect them? What is the indicator? And How can you solve them (if any)?	A challenge with special trianing programs is always the point to address a reasonable number of studetns. Very specialized programs can also result in a small number of students. The risk is if the number of students is too low, that the program becomes inefficient. One solution is to use ocourses in different programs more synergistically. Another strategy is the use of a modular system which can be exchanged optimum on an international level.

19	Identifying the training NEED and learning outcomes	How can we identify the training NEED and learning outcomes that fit with the future labor market? We need a good forecast of future labor market, but these info is difficult to obtain in developing countries like us. We are now running the survey via Questionnaire. but less/few feedback/ response is a big problem. What do you recommend/ advice? How to continue, How to solve, How to encourage "potential employers/ future students" to get involved in this process?	A regular interaction with stakeholders is required in a constant feedback loop. The practical trainings on site of companies as well as master thesis in conjunction with industrial partners is improtant. Moreover, each course has to update on a regular basis and commissions have to evaluate if the current contents are still fit for the future labour market.
20	The partnership with industry/ students associations	What do we have to take care of while starting a new program? Is the partnership with industry/ students associations needed? How can you develop such a good partnership?	Stakeholders (i.e.industrial partners) have to be invilved form the very beginning in order to identify the present and future requirements and expertise of the students and thus to define the learning outcome of the master#s course as well as the individual courses within the master mrogramme. A partnership with students associations as well as the involvement of students in the development of themasters program is not only an asset but a rperequisite. Creative thinking must be on the first page of the development before going into administrative details.
21	Difference/ Gaps between the university expertise/ resources and young generation's "taste"/ desire	Basically, we only can develop a GOOD training program based on our expertise/ resources and fit future labor market demand, BUT the training program must fit with the young generation's "taste"/ desire too. How does the EU partners deal with such optimization problems that are often opposite?	As a matter of fact, we do encounter the contrary. Sometimes the problem is not related to the content of the programme but the marketing. Therefore, the students have to be provided on how the programme fits e.g. in sove current questions such as sustainability, climate change etc. Therefore it is not a problem of the learning contents and outcomes but of the proper description and explanation what all is possible with the provided study program.

Best practice survey Universita' degli studi di Catania (UNICT)

No.	Topic/ Issue	Questions	Answers
1	Program Name	What is the name of your Master program?	CHEMICAL SCIENCES (ITA: Scienze Chimiche)
2	Target group	What are the target groups/ potential students?	Graduates from BA courses in Chemistry, Industrial Chemistry and/or other bachelor degrees.
3	Admission requirements	What are the admission requirements for your program?	The graduates of class L-27 Chemical Sciences and Technologies, ex-DM 270/04, and those of class L-21 Chemical Sciences and Technologies, ex-DM 509/99 have the curricular requirements to be admitted to this Master's degree. Graduates from other classes are also eligible, provided that they meet the following minimum curricular requirements: 48 ECTS distributed in the disciplinary scientific fields MATH, PHYS, BIO and CHEM, of which at least 6 ECTS in MATH sectors, at least 6 ECTS in PHYS sectors and at least 30 ECTS in CHEM sectors.
4	Required prerequisite knowledge	What are the required prerequisite knowledge that the student(s) must have to fullfil the admission?	For admission to the MA course Programme in CHEMICAL SCIENCES, it will also be necessary to demonstrate an adequate individual preparation in the following subjects: - Basic chemistry: analytical, physical, inorganic, organic; - Mathematics and physics; - Practical skills in chemical laboratories; - Knowledge of the English language corresponding to at least level B2.
5	Study programme's relevance	What is the relevance/ advantages/ strengths of your MSc study program?	The Department of Chemical Sciences has recently modified the Master's Degree courses with the aim of rationalizing, modernize and expand its educational offer and thus to give its graduates a cultural preparation more relevant to the new challenges of a society whose needs change quickly. The approach chosen was to propose a single MA degree course with four different curricular fields. It is therefore considered to offer students, within the general framework of Chemical Sciences, the possibility of a flexible educational choice adapted to their aspirations and propensities.
6	Program objectives	What are the objectives of your MSc program?	The MA degree Course in Chemical Sciences aims to prepare highly professional figures able to operate in laboratories, structures, institutions and companies, both in the public and the private sector, in the various fields related to the Chemical Sciences.

7	Career opportunities	What are the career opportunities for your graduate students? What type of job he/she can do?	The graduates in the Master in Chemical Sciences will have acquired useful skills also for a possible continuation of the formative course with other levels of formation including PhD, Master or courses of post-graduate formation. The master's degree in Chemical Sciences has job opportunities in the industrial, services and liberal professions. In detail: - industrial sector: chemical, petrochemical, polymer, electronics and microelectronics industry; mechanical and electromechanical industry; energy industry; bio-materials and biomedical industries; pharmaceuticals and cosmetics industry; industry of colours and paints; industries of the agri-food sector, food supplements and nutraceuticals; industries of materials and products for construction; industries of ceramics, glass and technologyglass; companies active in the environment and conservation of cultural heritage; biotechnology industries; textile industries; - -service sector: universities, public and private bodies CNR, ENEA, Istituto Superiore di Sanita`, Ministries, Customs, Hospitals, ASL, Chambers of Commerce, Regions, Provinces, Municipalities, ARPA, aqueducts, purification plants, etc.; chemical analysis laboratories in general, as environmental control, merchandise, cultural heritage; as an analyst in hospitals and chemical-clinical analysis laboratories; in the field of advertising and scientific dissemination. - professional activity: the graduate, after passing the examination of qualification to practice, and after registration in the register of the Order of Chemists and Physicists- CHEMICAL SECTOR; can play the professional role of CHEMIST with the powers provided by law.
8	Learning Outcome	What are the learning outcomes of your MSc program?	**"knowledge" and "ability**" for the the core teaching courses of the MA in CHEMICAL SCIENCES and the "**skills"** to be used in the job market: - Applied Analytical Chemistry (Strengthen basic analytical skills and develop the capacity to critically analyse real environmental, food and industrial cases); - Advanced Physical Chemistry (To develop advanced physical chemistry skills useful for the study of complex systems in condensed phase); - Advanced Inorganic Chemistry (Provide expertise on the synthesis and properties of inorganic materials, inorganic photochemistry and homogeneous inorganic catalysis); - Synthesis and Reaction Mechanisms in Organic Chemistry (Enhancing skills on sustainable organic chemistry, asymmetric synthesis and reaction mechanisms).

9	Indicators of competence achievement	What are the Indicators to achieve the competence by the students?	Compulsory attendance of at least 70% of the lessons is required. The student who has not acquired the frequency of the courses provided by his training, in the previous year, is enrolled regularly in the following year, without prejudice to the obligation to attend the courses of which it has not obtained the certificate of attendance. For the attainment of the magistral degree the student prepares a thesis (correspondent to 32 CFU) elaborated in original way. The preparation is verified by profit-based oral exams (EsO), in the case of individual courses and in the case of several integrated courses, or by interviews (Co) for credits related to other teaching activities. Profit-based examinations may include several stages, including written or practical ones, but are nevertheless concluded in oral form by means of an interview between the student and the Examining Board, to ascertain the degree of learning and understanding of the topics contained in the syllabus of the course to which it refers. The assessment of the exam is expressed in thirtieths and will take into account any tests carried out in the interim and the results achieved in any written or practical tests. The exam is however summative and as such, for its passing, must be carried out in its entirety. For the exam to be passed, a minimum vote of 18/30 must be obtained. Particularly brilliant results can be reported by the additional mention of the praise. The exam score will be reported only on the report.
10	Academic content and description of the study programme	Please provide the description of the MSc programme and contents of subjects in the training program.	In the various courses will be deepened the aspects of chemical sciences concerning: - the synthesis, the obtaining from natural sources and the characterization of organic molecules and macromolecules; - the use of computational models and methods for the study of chemical systems; - proteomics, enzymatic catalysis and organocatalysis; - the design and preparation of new materials according to their use properties; - the use of advanced instrumental methodologies for the control of the properties-structure relationships of functional materials also on micro- and nanometric scale; - the use of chemical and instrumental methodologies for the study of biological and complex systems; - devices for biomedical applications; - bioinorganic and bioorganic chemistry; - eco-sustainable products and processes for the chemical industry;

			- chemical methodologies for the environment and cultural heritage.
11	Study tracks	How many study tracks do you have? How can you decide the subject area to be studied in depth?	The MA degree course in CHEMICAL SCIENCES (LM54-SC) has a **core of common teachings (24 ECTS)** in the four basic chemical disciplines, and a articulation in **four curricula**, of which three are taken, renewing it, the educational offer of the three previous master courses in : - Biomolecular Chemistry (Curriculum-CABLE); - Materials Chemistry and Nanotechnology; - Organic and Bioorganic Chemistry (Curriculum-COB); and a fourth curriculum that addresses aspects of Chemical Sciences in the fields of industry, environment and cultural heritage: - Industry, Environment and Cultural Heritage (Curriculum-IABC)
12	Practice types	What kind of practices (beside lab works) that your MSc students will take for each subject?	a) Additional language skills: Not planned b) Computer and telematic skills: Not foreseen c) Training and guidance placements: Not provided d) Other knowledge useful for integration into the world of work: 2 ECTS dedicated to training activities consistent with the provisions of Article 18 of the Teaching Regulations ('Regolamento Didattico) of the University, which will be scheduled at the beginning of the academic year.

13	Final examination and assessment	How do you organize the final exam and assessment?	The final exam includes the presentation of a thesis elaborated in an original way by the student under the guidance of a supervisor. In the final exam the graduate will have to explain and discuss with clarity and mastery the results of the work carried out on the original research project, experimental or theoretical, on a specific theme, which is assigned to the student by the Degree Programme Board and carried out under the supervision of the appointed teacher, assisted, in the case of projects concerning internships in companies or research and development entities outside the University, by an Expert of the host institution. The grade of the final test takes into account both the student's career and the Commission's judgment.
14	Electives	How many electice subjects (and its credits) are there in your MSc program?	The MA course program provides for the acquisition of 12 ECTS of subjects of the student's choice. For the acquisition of optional loans the student can propose both lessons activated by the University and any type of training activity organized with the approval of the Board of Study Course that approves its consistency with the training objectives of the Course. For the acquisition of such credits it is necessary to pass the examination or other form of profit verification.
15	Requirements for the teaching staff / program manager	What are the minimum requirements for the teaching staff / program manager? (In term of their qualifications and experiences; The autonomy of the professor to take lead on research	Expertise in the scientific fields to which the MA course refers (e.g., analytical chemistry, physical chemistry, inorganic chemistry, industrial chemistry, organic chemistry, chemical engineering, environmental chemistry, biochemistry, biological chemistry)
16	External assessment of the educational activities quality	How do you do with external assessment?	We do the internal assessment with a board of teachers and administrative staff named Quality Assurance. As to the external assessment, we have two more boards, named Quality Management of the University (PQA) is responsible for the organization, monitoring and supervision of the University's Quality Assurance (AQ) procedures, and the Steering Committee (CI) for all courses of study provided by the Department. The CI consists of the Director of the Department, the Deputy Director of the Department, the Presidents of the Courses and representatives of the business word and professional orders.

17	Some special features	What are the special features of your MSc program?	Our MA course in CHEMICAL SCIENCES proposes four different curricula to offer students, within the general framework of Chemical Sciences, the possibility of a flexible educational choice adapted to their aspirations and propensities.
18	Risks, challenges to develop the MSc program	Is there any risks/ challenges you may face from the beginning to develop the MSc program? If Yes, how can we realize/detect them? What is the indicator? And How can you solve them (if any)?	One identified risk can be the low number of enrolled students (indicator = numnber of students), especially if you fragment the MA course in different curricular pathways. To solve this problem, we think is crucial the preliminary audit of the environment (to avoid overlaps with existing offers) and also the communication about the new MSc (target: bothBA students and high school students, as well as families - though media press and social channels)
19	Identifying the training NEED and learning outcomes	How can we identify the training NEED and learning outcomes that fit with the future labor market? We need a good forecast of future labor market, but these info is difficult to obtain in developing countries like us. We are now running the survey via Questionnaire. but less/few feedback/ response is a big problem. What do you recommend/ advice? How to continue, How to solve, How to encourage "potential employers/ future students" to get involved in this process?	Preliminary (at the M.Sc. design stage) and periodic (during the M.Sc. running) meetings with the Steering Committee (CI) provided by the Department. These meetings have the aim to: of a) ensuring the connection of the Academia with the job market; b) evaluating the progress of the courses; c) preparing proposals for the definition and design of training and proposals for the definition of learning objectives; d) suggesting development guidelines; e) promote contacts for student internships in companies.
20	The partnership with industry/ students associations	What do we have to take care of while starting a new program? Is the partnership with industry/ students associations needed? How can you develop such a good partnership?	The partnership with industry is certainly relevant, and we would add, necessary for the accomplishment of the aimed objectives for the M.Sc. The involvement of students associations (student representatives) is strongly advised. To develop a good partnership we advise to organize seminars and lectures given by industry managers and/or experts.
21	Difference/ Gaps between the university expertise/ resources and young generation's "taste"/ desire	Basically, we only can develop a GOOD training program based on our expertise/ resources and fit future labor market demand, BUT the training program must fit with the young generation's "taste"/ desire too. How does the EU partners deal with such optimization problems that are often opposite?	The University teaching and technical staff members should be constantly trained to fit their expertise/resourses to the new challenges of a society whose needs change quickly.

Best practice MSc Program Germany

1. Programme name

MSc program - Environmental Pollution Management (Ecotoxicology) (The University of Koblenz-Landau,)

2. Site

https://www.uni-koblenz-landau.de/en/campus-landau/faculty7/info-prospective-students/master-of-science-ecotoxicology?gclid=Cj0KCQjwkIGKBhCxARIsAINMioL8MTUsFymoNPOXLMI5JbKm9DQ1gT2Rn2nl72dkVRwwQ23EdiwTf9caAi6KEALw_wcB

3. Target group

Admission requirements	1. Bachelor's degree 2. English proficiency
Required prior knowledge	*Academic Background* A Bachelor degree in Environmental Science, Natural Science or Earth Science is required. Basic academic knowledge may be acquired in the fields of Ecology, Environmental Chemistry, Geographic Informations Systems and Mathematics/Statistics. If necessary, previous knowledge may be complemented in preparatory courses. *Language Proficiency* **English** The Program is conducted in English. Therefore, good active and passive English language skills are essential. However, no formal proof of English proficiency (e.g., IELTS, TOEFL) is required. **German** Proficiency of German is not a requirement for application. However, we recommend to learn some basic German for daily life. While Germans also speak English, you will generally find life in Germany easier if you speak German.
Study programme's relevance	An increasing number of chemicals is used by society today, which are also released into the environment. Environmental Pollution Management (Ecotoxicology) is concerned with their potential impacts on the ecosystem. It aims to investigate and discover effects of chemicals on biological systems in order to develop methods for risk management, as well as to predict ecological consequences.
Program objectives	The goal of the international "Master of Science program in Environmental Pollution Management (Ecotoxicology)" is interdisciplinary environmental and sustainability education and to train professionals capable of easily use knowledge from a wide range of fields for environmental protection and decreasing human and technical waster products.

4. Career opportunities

The Program enables the graduates to conduct independent scientific work and prepares in particular for independent and leading positions in the numerous emerging fields of Environmental Pollution Management (Ecotoxicology). The graduates are able to take responsibility in a professional manner in: Scientific facilities and research institutes, authorities, public offices and ministries with a regulatory role, Non-governmental organizations, industry and consulting enterprises. The international orientation of the program qualifies graduates for a global job market. In addition, the Master program prepares for a PhD study.

5. Learning Outcome

The international "Master of Science program in Environmental Pollution Management (Ecotoxicology)" integrates concepts of Environmental Chemistry, Environmental Toxicology, Ecology, Pollution Management and includes

Social Sciences and Economics as well. Due to its interdisciplinary and applied approach, the Program enables its graduates to analyze complex environmental problems and to develop practical solutions.

6. Indicators of competence achievement

120 credits and diploma project

7. Academic content and description of the curriculum

All students take the 9 required modules, as well as a 10-week Research Project Course and an Applied Module at External Organisations of 8 weeks to obtain a deep knowledge in the field of Environmental Pollution Management (Ecotoxicology). Afterwards, students personalize the Program by choosing 2 Modules of the 5 Specialty Areas. Students finish the 4-semester Program with their master thesis.

Specialty Areas:

- Applied Environmental Chemistry & Environmental Physics,
- Chemistry,
- Data Analysis & Advanced Modelling,
- Applied Ecology,
- Geoecology and
- Socioeconomics & Environmental Management

Semester 1

Environmental analysis – 6 ECTS
Principles of ecotoxycology – 6 ECTS
Tools for complex data analysis – 6 ECTS
Effects of Chemical Stressors I – 5 ECTS
Effects of Chemical Stressors II – 5 ECTS

Semester 2

Methods in Ecotoxicology – 9 ECTS
Molecular ecology I – 6 ECTS
Applied Module at external organizations – 10 ECTS

Semester 3

Models in ecotoxicology – 6 ECTS
Risk Assessment and Management – 6 ECTS
Research modules from the specialty areas – 12 ECTS
2-3 semesters – optional 2 modules (12 ECTS) ,

Semester 4

Master Thesis (30 ECTS)

Study tracks	*Course breakdown*

ETX1: Methods in Ecotoxicology

You are introduced to methods according to Good Laboratory Practice (OECD) and get to know different ecotoxicological test systems that are used in a regulatory context. Students acquire the understanding of how to work under quality assurance systems, following OECD and GLP guidelines, which are then applied practically in an experiment and summarized in a report.

ETX2: Principles of Ecotoxicology

Students acquire the knowledge of terrestrial and aquatic ecotoxicology, i.e. the effects of chemicals on individual organisms. The curriculum further expands on ecotoxicological effects from to population up to the ecosystem level, how to identify and evaluate proper testing procedures. The module is concluded by learning strategies of how to address such environmental challenges in order to manage ecotoxicological risks and associated adverse outcomes.

ETX3: Tools for Complex Data Analysis

Students learn to design a study and select the corresponding tools for subsequent data analysis. They become able in linking scientific questions to the required methods of data analysis and data processing. With a deepening knowledge, ranging from univariate to multivariate or novel machine-learning approaches, students become more familiar with advantages and disadvantages of respective analysis tools.

ETX4: Effects of Chemical Stressors I

Students are taught the principles of toxicology by leading toxicological experts from the chemical industry. With this course, students acquire the knowledge of routes and reactions in the metabolism, mechanisms of cancerogenity, toxicokinetics, toxicodynamics and become able of deriving toxicological and pharmacological profiles. Knowledge is applied in the laboratory, conducting mutagenicity, developmental, and biotransformation experiments.

ETX5: Effects of Chemical Stressors II

Ecotoxicological knowledge is deepened, learning the interactions of chemical stressors with various organismic and higher-level structures that result in ecosystem alterations impairing their structure, function or ability to provide ecosystem services. Students are then introduced to Landau's research coordinators and integrated into ongoing research, based on student's preference, ability and interest. Thus, students gain a first glimpse into project planning and execution, as well as an early opportunity to become a member of Landau's Institute for Environmental Sciences (iES) research teams.

ETX6: Environmental Analysis

The students gain advanced knowledge about the production, use and effects of various classes of environmental pollutants and their pathways in different ecosystems, including transfer, transformation and transport of pollutants. The course is complemented with practical lab exercises where students will learn sampling and extraction methods for pollutants followed by chemical analysis using GC- and LC-MS.

ETX7: Molecular Ecology I

The students become familiar with major topics in molecular ecology and basic theories of population genetics and phylogenetics. They get an overview of possible methods in molecular ecology and learn examples of their application. The students gain practical experience in phylogenetic analysis software and will be able to interpret the results. Finally, students become capable in applying and interpreting genetic data in the context of ecotoxicology, i.e. the potential effects of chemicals on genetics

ETX8: Models in Ecotoxicology

The students learn the basic principles of models to be used in the exposure or effect assessment in ecotoxicology. They gain insight into the restrictions, sources of errors and are enabled to quantify the uncertainty associated with them. They learn how to use models and to identify situations in which a modelling approach can be of help. They gain the ability to independently analyze a problem situation, to apply a suitable modelling approach and to interpret the results obtained.

ETX9: Risk Assessment and Management

The students acquire the principles of risk assessment and environmental pollution management of chemicals in Germany, the EU and internationally. They will become aware of the legislative and non-legislative background to risk assessment and risk management, the procedure and the role different stakeholders play. They learn to evaluate existing data in order to conduct deterministic and probabilistic risk assessments and to derive appropriate risk mitigation strategies. Students are introduced to software and other IT-solutions that are commonly used in the field of regulatory risk assessment and ecological evaluations for the registration of chemicals.

8. Practice types

Applied Module at External Organizations (AMEO)

The module AMEO is an 8-week internship, which can be performed at an external university or a governmental or industrial research institute in Germany or abroad. Students become familiar with working practice, requirements of the job market and career opportunities and can establish business contacts. They apply, confirm and expand knowledge and competences achieved during their study.

Following an introductory discussion with the supervisors, the students perform the (research) work on their own and discuss the obtained results regularly with their supervisors. The content depends on the actual research

questions in the selected research organizations. Topics or possible positions will be suggested by the staff of the Institute for Environmental Sciences or maybe suggested by the students. The topics should be directly related to applied problems relevant in these external organizations and should ideally offer the students opportunities to apply their knowledge and skills in areas, which are not the particular research areas at the Institute for Environmental Sciences in Landau. They include, but are not restricted to the following areas:
Engineering aspects (e.g. hydrology, mitigation techniques)
Multimedia modelling
Food web modelling
Fish, bird or mammal ecotoxicology and risk assessment
Agricultural sciences
Socioeconomics
Specific aspects in regulatory ecotoxicology
Risk communication, economic or societal aspects

Research Project Course (RPC)
The students work independently on a research topic of the university for a total time of about 10 weeks. The topics depend on the actual research conducted in the various research groups. However, all topics do have an interdisciplinary character covering at least two different disciplines (e.g. chemistry and ecology, or physics and risk assessment). The students submit proposals for topics selected from a list provided by the teaching staff including a time and resource planning as well as an independently conducted literature search. Following an introductory discussion with the supervisor, the students perform the research work on their own and discuss the obtained results regularly with their supervisor. Following the practical work, the students write a report including the theoretical background, the methods used, the results obtained and a discussion of the results based on the relevant scientific literature. The students present and defend the outcome of their work at an oral presentation. Following successful completion, the students are able to plan a scientific work package, conduct the work, evaluate the results based on the relevant literature and present the outcomes.
The content depends on the actual research questions in the research groups associated with the Institute for Environmental Sciences. They include, but are not restricted to the following areas:
Chemical experiments in the lab
Environmental colloid chemistry
Environmental organic chemistry
Physical transport or transfer processes of environmental chemicals
Ecotoxicological lab tests
Ecotoxicological field studies
In situ or monitoring work in the field
Molecular genetics
GIS data analysis
Data analytics, modelling, and machine learning
Literature reviews
Exposure, effect or landscape modelling
Assessment or management of risks

9. Final exam and assessment

MSc Dissertation

10. Optional

Research modules from the specialty areas – 12 ECTS
2-3 semesters – optional 2 modules (12 ECTS)

11. Requirements for teaching staff / program manager

PhD

12. External assessment of the quality of educational activities

Institute for Environmental Sciences Landau

13. Some special features

The Master in Environmental Pollution Management (Ecotoxicology) is organized by the Institute for Environmental Sciences Landau and its graduates receive the full credits for the nine required topics of the Society of Environmental Toxicology and Chemistry's Certification of Environmental Risk Assessors (CRA) program.

Best practice MSc Program Sweden

1. Programme name

MSc program - Chemical Engineering for Energy and Environment (KTH Royal Institute of Technology, SE-100 44, Stockholm, Sweden)

2. Site

https://www.kth.se/en/studies/master/energyandenvironment/course-overview-1.268222

3. Target group

Admission requirements	1. Bachelor's degree 2. English proficiency
Required prior knowledge)	1. A bachelor's degree. Students in the final year of undergraduate studies may apply and, if qualified, be conditionally admitted. 2. English language proficiency. Detailed information on how you can meet the language requirement is provided by University Admissions .
Study programme's relevance	Chemical engineers with a specialization in energy and the environment are very attractive for many different branches of industry, such as suppliers of energy and chemicals, the pulp and paper industry, the vehicle industry and in companies specializing in environmental issues such as the recycling of materials ...
Program objectives	The master's programme in Chemical Engineering for Energy and Environment delivers extensive knowledge in the diverse field of Chemical Engineering with a focus on sustainability. Students acquire modern tools to analyse various processes, from the production of biofuels to the purification of drinking water. Graduates have the engineering skills needed to meet the societal challenge of how best to use our available energy and finite natural resources

4. Career opportunities

The program graduates can be found in traditional Swedish industry, in small start-up companies, consultant companies, governmental institutions, research institutes and universities. Examples of companies that employ chemical engineers from KTH are energy-related companies such as Fortum, Stockholm Exergi and Vattenfall, companies in the pulp and paper industry, e.g. Holmen and Stora Enso and research institutes like RISE and IVL, chemical production companies like Akzo Nobel and Nynäs and car and truck manufacturing companies like Scania (buses and trucks), Volvo AB (buses, trucks and construction machines) and Volvo Cars (cars) ... A lot of graduates also continue their academic career with doctoral level studies. The need for engineers with the competence offered by the program will continue to be great in the future.
Students on the programme will gain advanced knowledge and skills in chemical engineering and obtain modern tools to analyse various processes. These processes can be anything from the production of biofuels and energy storage to the purification of drinking water and exhaust gases. Students will acquire competence through the whole chain, from raw materials to final product. The analyses of the processes often include aspects of chemicals, heat, electricity and the environmen

5. Learning Outcome

Students on the programme will gain advanced knowledge and skills in chemical engineering and obtain modern tools to analyse various processes. These processes can be anything from the production of biofuels and energy storage to the purification of drinking water and exhaust gases. Students will acquire competence through the whole chain, from raw materials to final product. The analyses of the processes often include aspects of chemicals, heat, electricity and the environment.
The two-year master's programme in Chemical Engineering for Energy and Environment consists of three terms of courses and one final term dedicated to the master's degree project. Each term consist of approximately 30 ECTS credits.

It is advisable to take at least two of the conditionally elective courses during study year. Observe that you cannot get a degree from the programme without at least two out of five conditionally elective courses.

6. Indicators of competence achievement

120 credits and diploma project

7. Academic content and description of the curriculum

Year one and the first term of the second year consist of conditionally elective and recommended courses, allowing students to design their education to meet personal and professional goals. The remainder of year two consists of a compulsory project course in process design for industry and society. During the last term of the programme, a degree project is carried out either in industry, at a KTH department, or another university or research institute around the world

Study tracks	Complementary skills such as problem-solving and teamwork are emphasised on many of the courses, as is written and oral communication. The courses are, therefore, to a large degree based on seminars and project assignments as a complement to traditional lectures.

Year 1

Mandatory courses

- Theory and Methodology of Science with Applications (Natural and Technological Science) (AK2036) 7.5 credits

Conditionally elective courses

- Environmental System Analysis and Decision making (AL2181) 7.5 credits
- Industrial Energy Processes (KE2010) 7.5 credits
- Chemical Reaction Engineering (KE2045) 7.5 credits
- Transport Phenomena, Advanced Course (KE2070) 7.5 credits
- Separation Processes (KE2185) 7.5 credits

Recommended courses

- Cleaner Production and Industrial Environmental Technology (AL2143) 7.5 credits
- Environmental Management (AL2160) 7.5 credits
- Nuclear Chemistry (CE2010) 7.5 credits
- Carbon dioxide neutral energy and transport system (CK2010) 7.5 credits
- Environmental Catalysis (KE2051) 7.5 credits
- Computational Project in Chemical Engineering (KE2060) 7.5 credits
- Applied Electrochemistry (KE2110) 7.5 credits
- Renewable Fuel Production Processes (KE2130) 7.5 credits
- Electrochemical Energy Devices (KE2300) 7.5 credits
- Sustainable Systems for Heat, Power and Materials Production (KE2310) 7.5 credits
- Risk Analysis and Management for Chemical Engineers (KE2351) 7.5 credits
- Resource recovery from waste (KE2355) 7.5 credits
- Ideation- Creating Your Own Company (ME2814) 7.5 credits

Year 2

Recomended courses may be cancelled if number of admitted students are less than minimum of places, or will be given every second year.

Study year 2 consists of one mandatory course, more conditionally elective courses, recommended courses and a mandatory degree project, second level, 30 higher education credits.

See the list below;

Degree Project in Chemistry, Second Cycle - KD200X

Degree Project in Chemical Engineering, Second Cycle - KE200X

Degree Project in Fibre and Polymer Technology, Second Cycle - KF200X

Mandatory courses

- Process Design for Industry and Society (KE2325) 15.0 credits

	Recommended courses • Corrosion and Surface Protection (KD2380) 7.5 credits • Experimental Process Design (KE2195) 7.5 credits • Pharmaceutical Technology (KE2331) 7.5 credits Pulp and Paper Processes (KF2470) 7.5 credits

8. Practice types

A majority of the courses include laboratory work in the research labs. The education is closely linked to the research conducted at the School of Engineering Sciences in Chemistry, Biotechnology and Health at KTH in general, and the Department of Chemical Engineering in particular. The programme also has close links to Swedish industry, especially the motor vehicle industry through Scania and Volvo, and the utility industry through Fortum och Vattenfall. The programme provides an excellent basis for activities in countries outside Sweden, as most of the teachers have close contacts with foreign universities and companies. There are good opportunities to study parts of the programme abroad through student exchange with other prominent universities in the field of chemical engineering or degree project abroad
The remainder of year two consists of a compulsory project course in process design for industry and society. During the last term of the programme, a degree project is carried out either in industry, at a KTH department, or another university or research institute around the world

9. Final exam and assessment

MSc Dissertation

10. Optional

Recommended courses

- Cleaner Production and Industrial Environmental Technology (AL2143) 7.5 credits
- Environmental Management (AL2160) 7.5 credits
- Nuclear Chemistry (CE2010) 7.5 credits
- Carbon dioxide neutral energy and transport system (CK2010) 7.5 credits
- Environmental Catalysis (KE2051) 7.5 credits
- Computational Project in Chemical Engineering (KE2060) 7.5 credits
- Applied Electrochemistry (KE2110) 7.5 credits
- Renewable Fuel Production Processes (KE2130) 7.5 credits
- Electrochemical Energy Devices (KE2300) 7.5 credits
- Sustainable Systems for Heat, Power and Materials Production (KE2310) 7.5 credits
- Risk Analysis and Management for Chemical Engineers (KE2351) 7.5 credits
- Resource recovery from waste (KE2355) 7.5 credits
- Ideation- Creating Your Own Company (ME2814) 7.5 credits
- Corrosion and Surface Protection (KD2380) 7.5 credits
- Experimental Process Design (KE2195) 7.5 credits
- Pharmaceutical Technology (KE2331) 7.5 credits

Pulp and Paper Processes (KF2470) 7.5 credits

11. Requirements for teaching staff / program manager

PhD

12. External assessment of the quality of educational activities

Administration of KTH Royal Institute of Technology

13. Some special features

Recommended courses may be cancelled if number of admitted students are less than minimum of places, or will be given every second year.
Students from the Degree Programme in Energy and Environment (CENMI) have to study the course AL2181 Environmental System Analysis and Decision-making